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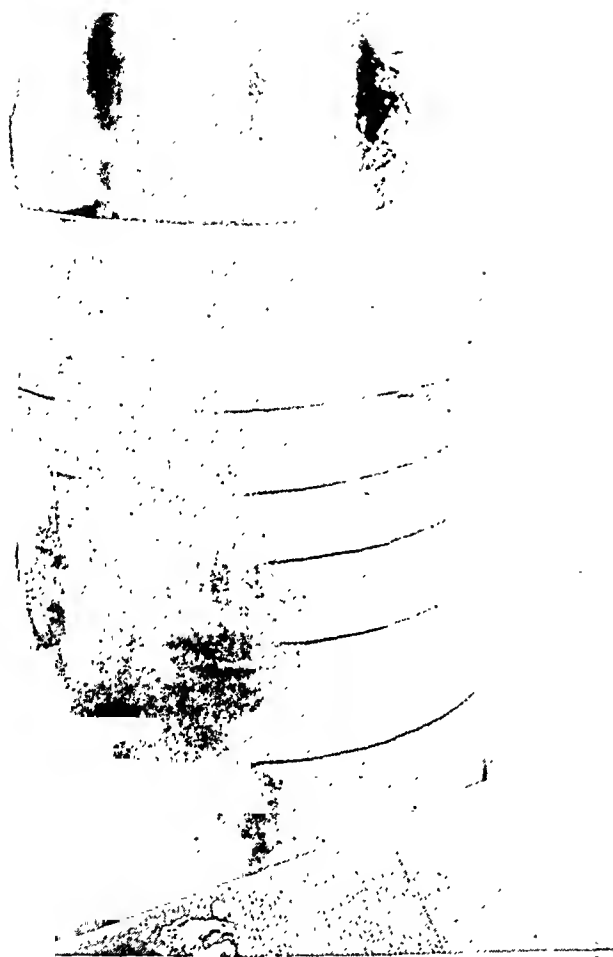
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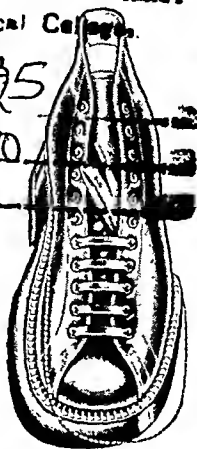
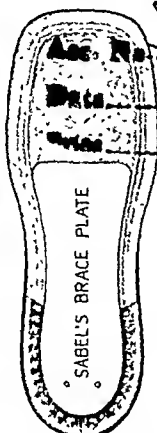
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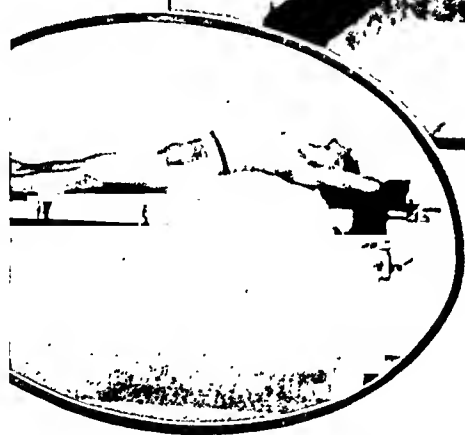
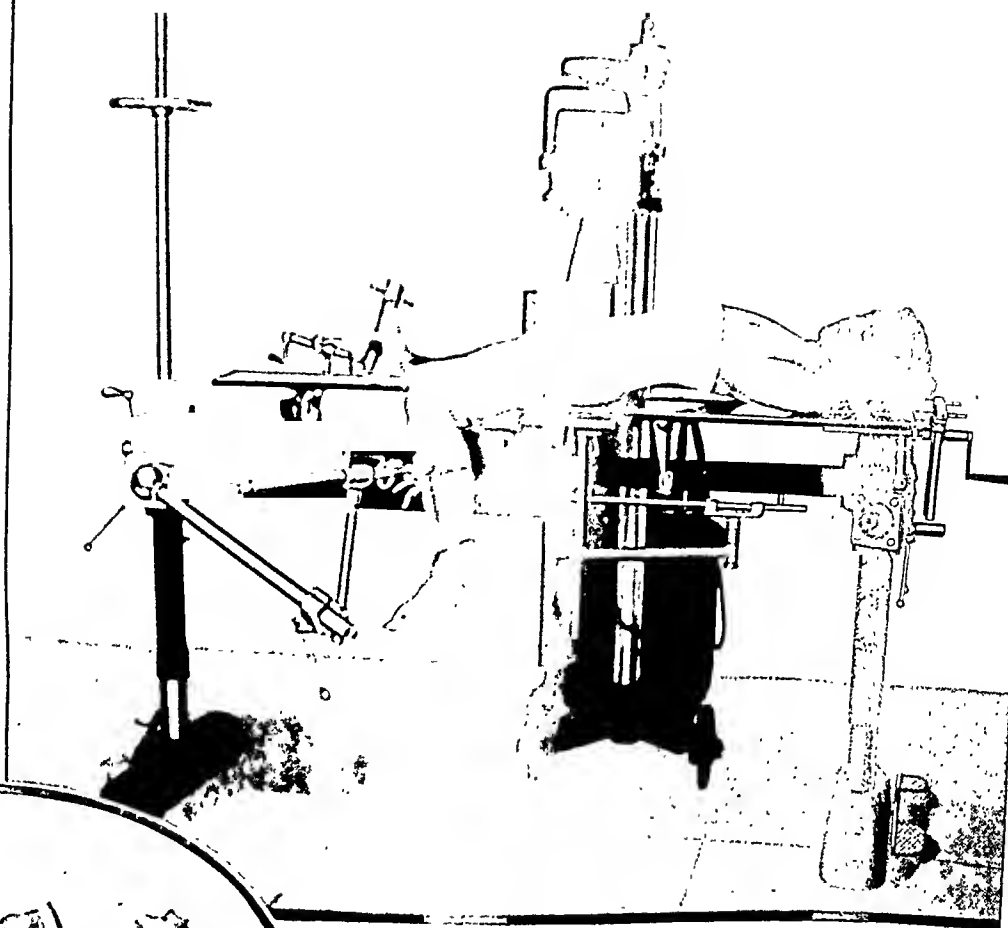
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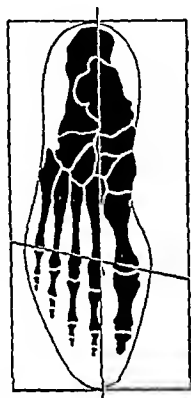
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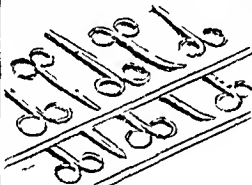
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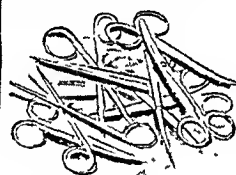
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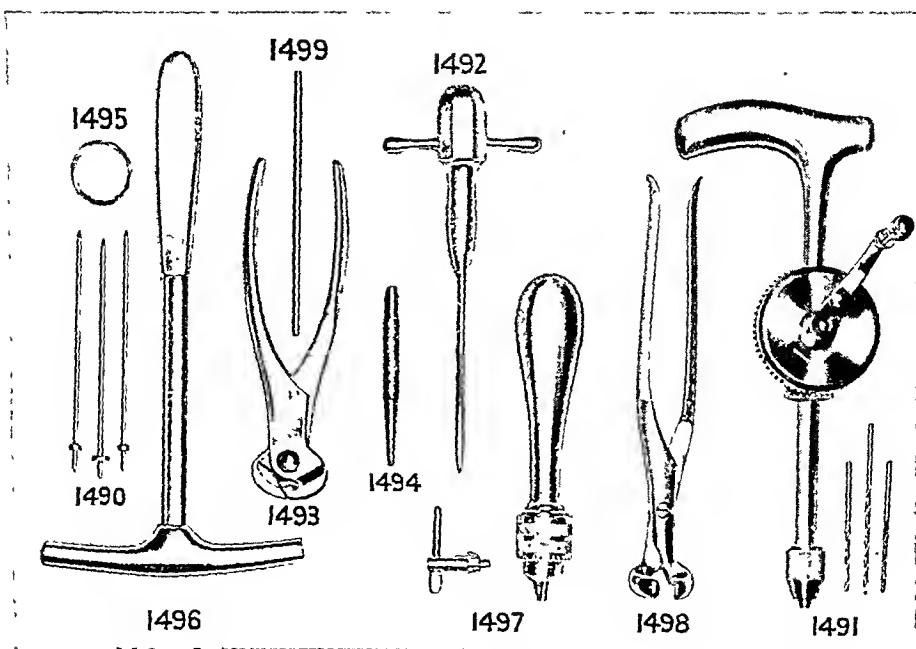
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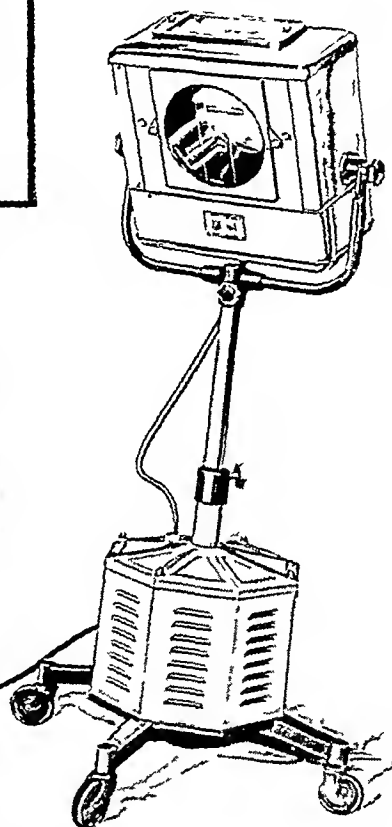
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THE JOURNAL OF BONE AND JOINT SURGERY

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# The Journal of Bone and Joint Surgery

## XANTHOMATOUS TUMORS OF JOINTS \*

BY DOMINIC A. DE SANTO, M.D., AND PHILIP D. WILSON, M.D.,  
NEW YORK, N. Y.

The attention now focused on bone tumors has had the effect of throwing into relative obscurity similar lesions of the articular structures. Certainly the study of tumors arising from the synovial membrane of the joints has been comparatively neglected. Yet there is equal need of obtaining knowledge of these lesions in order to guide the surgeons who are confronted with the problem of deciding how to deal with them.

The purpose of the present paper is to report the results of a study of xanthomatous tumors of the synovial membrane of the joints. Our own interest in this lesion was aroused by personal experience with several cases, and since then we have reviewed the literature and succeeded in finding thirty-two reported cases. There were scattered references to five additional cases, but these could not be used because of insufficient data and uncertain diagnosis. We have also made an effort to collect as many additional cases as possible, and, thanks to material that has graciously been put at our disposal by various interested physicians, as well as that obtained from our own patients, we have succeeded in accumulating a total of nine cases for detailed study. We wish to take this opportunity of acknowledging our indebtedness to the following physicians who contributed cases: Dr. B. L. Coley, Dr. L. C. Wagner, Dr. Toufiek Nicola, Dr. T. C. Thompson, and Dr. V. S. Johnson of the Hospital for the Ruptured and Crippled, New York, N. Y.; Dr. Arthur Wright, New York, N. Y.; and Dr. George E. Bennett of Baltimore, Maryland.

### CLASSIFICATION

Tumors of the synovial membrane of the joints are relatively uncommon, and of these the xanthoma is of most frequent occurrence. This statement is based upon an analysis of 109 cases, of which fifteen were reported by Geschickter and Copeland, seventy-four by Razemon and

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 18, 1939.

TABLE I  
CLASSIFICATION OF 109 J...

	Razemon and Bizard	Geschickter and Copelan <sup>1</sup>	Hospital for the Ruptured and Crippled	Total
<b>Benign:</b>				
Xanthoma.....	26	5	9	40
Angioma.....	17	1	4	22
Fibroma.....	1	1	0	2
Giant-cell tumor.....	0	3	2	5
Lipoma.....	1	4	1	6
Total.....	45	14	16	75
<b>Malignant:</b>				
Synovioma*.....	0	0	3	3
Chondromyxosarcoma.....	3	0	0	3
Liposarcoma.....	1	0	0	1
Fibrosarcoma.....	25	1	1	27
Total.....	29	1	4	34

\* We limit the term "synovioma" to malignant tumors arising from the lining mesothelium of the synovial membrane, but there is as yet no agreement as to this usage.

Bizard, and twenty were found in the records of the Pathological Laboratory of the Hospital for the Ruptured and Crippled. The classification of these tumors and their distribution are shown in Table I.

#### HISTORICAL REVIEW

The first case of xanthoma reported in medical literature is that described by Gustav Simon in 1865. The tumor was located in the knee joint of a male, aged forty-six. Microscopically, spindle cells, irregularly shaped pigmented cells with oval nuclei, large giant cells, and occasional "fatty cells" were described. Turner, in 1894, reported a pedunculated tumor arising near the lateral meniscus. In the United States Weir reported three undoubted examples.

Dowd, writing under the title of "Villous Arthritis of the Knee", described a case of multiple tumors of the synovial membrane, which showed many of the microscopic features of the xanthoma, although foam cells were not described. The use of the term "villous arthritis", though confusing, is rather interesting, because it finds repetition in a recent article by Kling and Sashin.

Hartman reported a case of diffuse xanthomatosis of the knee in a male, aged twenty. Aspiration was performed twice weekly for two months with the removal of about fifty cubic centimeters of bloody cloudy fluid on each occasion. Arthrotomy was finally performed, and several tumors were removed. The joint continued to enlarge and to re-

main painful and was, therefore, reopened. One large and several smaller tumors of the synovial membrane presented. The synovial-membrane surface was reddish brown. Large masses were excised. Five weeks later the joint was opened a third time, and a more extensive resection of the synovial membrane was performed. This was followed by uneventful recovery. The drawing of the pathological specimen is similar to one of our own cases.

More recently, Harbitz, in a general discussion of joint tumors, gave several examples of both benign and malignant varieties of joint tumors. Among the former were several tumors with giant cells, some containing foam cells and others none. Kling and Sashin reported an obscure swelling of the left knee joint of two years' duration occurring in a male, twenty-three years old, with a history of occasional pain for ten years. Thick bloody fluid was aspirated on several occasions. At operation the synovial membrane was dark red or brown and studded with masses of polypoid villi. Microscopic examination showed hypertrophy of the synovial membrane with villi containing clumps of blood pigment and clusters of giant cells. No foam cells were described. The blood cholesterol six months later was 288 milligrams per 100 cubic centimeters, indicating some hypercholesterolaemia.

Sonntag, in 1930, described a case and reviewed the literature up to his time. He found twenty known examples, of which seventeen were in the knee and three in the ankle, with no other joints involved. His own case was one of a pedunculated solitary tumor in the knee, and the histological examination leaves no doubt that it was a xanthoma. The blood cholesterol was 200 milligrams per 100 cubic centimeters.

In the French literature the articles of Lejars and Rubens-Duval and of Razemon and Bizard were especially outstanding, although they deal with the general subject of joint tumors, particularly the malignant tumors. A number of other articles reporting single cases of xanthomatous tumors were found.

#### CLINICAL FEATURES

The following discussion of the clinical features of xanthomatous tumors of synovial membrane is based upon an analysis of forty-one cases, of which thirty-two are quoted from the literature and nine are reported herewith. (See Table II.) We believe that these tumors are more common than the few reported cases would indicate and that they are frequently treated for long periods under the diagnoses of villous arthritis, chronic rheumatoid arthritis, loose body, joint mouse, or torn cartilage. It is even possible for the true nature of the lesion to be overlooked at operation.

#### *Incidence*

There was a preponderance of cases among males. Of the total of forty-one patients, twenty-four, or 59 per cent., were males, and seventeen, or 41 per cent., were females.



TABLE III  
AGE INCIDENCE

Decade	No. of Patients
10 to 20.....	8
21 to 30.....	15
31 to 40.....	11
41 to 50.....	5
51 to 60.....	2
Total.....	41

The great majority of the patients were between the ages of twenty and forty (Table III).

*Gross Characteristics—Operative Findings*

The gross characteristics of these tumors permit their subdivision into three types, the incidence of which is given in Table IV.

TABLE IV  
ANALYSIS OF TUMORS

Type	No. of Cases
Solitary.....	28
Multiple.....	6
Diffuse.....	6
Unclassified.....	1
Total.....	41

*Solitary:* The most numerous type is the solitary xanthoma. It is almost invariably pedunculated and attached to the synovial membrane at or near the medial meniscus. The suprapatellar pouch and the region of the lateral meniscus are also favorable sites. The tumors are rounded or spheroidal and present a golden yellow or orange color, studded with purplish-red or black areas representing hemorrhages of varying antiquity. They are encapsulated and smooth, and their consistency varies from soft to rubbery. The coloration is due to two factors: (1) the presence of hemorrhagic pigment, and (2) the presence of the lipoids of cholesterol and its esters.

*Multiple:* Several tumors—some polypoid and others pedunculated—may involve a portion of synovial membrane varying from two to several square centimeters in area. These tumors may be small and wart-like and may be associated with larger globular tumors, one or more centi-

meters in size. The underlying area of involved synovial membrane shows the same orange-yellow coloration as does the tumor, and this is a matter of some interest, as will be shown in discussing the pathogenesis. Six of the forty-one reported cases were of the multiple variety.

*Diffuse:* In the diffuse variety, the entire synovial membrane shows yellowish discoloration and is studded with innumerable small and large papillary, polypoid, and pedunculated nodules, varying in size from a few millimeters to a few centimeters. In between the innumerable tumors the appearance of the synovial membrane resembles that of a hemorrhagic arthritis, being arranged in exaggerated fern-like folds. The joint invariably contains serosanguineous hemorrhagic fluid or blood clots, whereas serous, straw-colored, or orange-colored oily fluid is usually present in some excess in the first two types.

Although there appears to be no sharp demarcation between any of the three types, it does not seem likely that the diffuse type arises as a later stage of the solitary. It seems more probable that in each type a limited or diffuse area of synovial tissue is predisposed to the development of one or more tumors.

The largest tumor was described as one and one-half times the size of a man's fist; the smallest, as bean-sized. In the multiple cases the individual tumors usually varied from five-tenths of a centimeter to two centimeters in diameter. In one of our diffuse cases all stages from tiny excrescences to a large tumor, one and five-tenths centimeters in diameter, were seen.

### *Location*

The tumors occurred predominantly in the knee joint,—thirty-six out of forty-one cases. In the remainder, four tumors were situated in the ankle joint and one in the joint between the navicular and the second cuneiform. Of the tumors occurring in the knee, eighteen were on the right, twelve were on the left, and in six cases the side was not stated. Of the tumors located in the tarsus, three were on the right and two on the left.

It seems noteworthy that xanthomatous tumors of the synovial membrane have only been reported as occurring in the joints of the lower extremity.

### *Trauma*

A history of trauma preceding the onset of the joint symptoms was obtained in twenty-three cases and was stated to be absent in seven. In eleven cases there was no mention of trauma in the histories, and it is impossible to know whether the patients were questioned about it. In twenty of the twenty-three cases with a history of trauma it was of a severe, direct variety capable of causing symptoms. In many of the cases the symptoms had their onset following trauma. The nature of the violence included such accidents as falling from a horse, being struck by a falling log, and the like. In one of the ankle cases a fracture of the

femur had been sustained, and the patient had been treated with traction apparatus applied to the leg for several weeks preceding the discovery of the tumor.

The evidence does not warrant a statement that trauma is the sole etiological factor, but it does point strongly to its playing a rôle either in producing enlargement of the tumor or in causing the onset of clinical symptoms. The facts that the majority of the cases occurred among males and in the age period when there is the greatest exposure to trauma would also lend support to this view.

### *Duration of Symptoms*

The shortest duration of symptoms was one day and the longest twenty years. Between these extremes all time intervals were given, and the average duration of symptoms was forty months. From this it may be seen that xanthomatous tumors may be present for a long time without severely handicapping the individual.

### *Pain*

Pain was a frequent symptom, being present in thirty-four cases, absent in two, and not mentioned in five. It was variously described as occasional, mild, intermittent, sharp, and, in a few instances, as constant and severe. In one case it was severe enough to necessitate immobilization of the joint. The pain was frequently aggravated by exertion such as walking or dancing, by motion of the joint in either flexion or extension, and sometimes by local pressure. At other times the pain seemed to be associated with distention of the joint, generally from fluid.

### *Locking*

Mechanical interference with joint motion, usually described as locking, was mentioned in seven of the histories. While locking was rare, various types of stiffness, catching, and temporary restriction of extension suggestive of mechanical derangement were described by other patients, which leads us to believe that it is a fairly common clinical feature of the disease. Such symptoms are more characteristic of the solitary or multiple types of tumor than of the diffuse.

### *Tumor*

The most common finding was a movable tumor, generally situated at the mesial side of the patella, which could be made to disappear into the joint by pressure or by flexion. In the diffuse or multiple types, associated with considerable effusion, a tumor was sometimes palpated after aspiration. In multiple cases more than one tumor was sometimes felt. A palpable tumor was reported in twenty-nine of the forty-one cases, and in fifteen of these it presented on the inner side of the patella. The outer side of the patella was second as the site of presentation, and the suprapatellar pouch was third. In twelve cases the tumor was not palpated, but was discovered at operation.

### *Swelling*

Swelling of some degree was mentioned in thirty-one cases; it was absent in five cases; and it was not mentioned in five cases. The swelling was due to effusion within the joint in most cases and was of a diffuse type. Sometimes the swelling was localized to an area about the tumor. The most pronounced swelling was seen in the cases in which at operation diffuse xanthomatous changes in the synovial membrane were found.

### *Aspiration*

Aspiration was performed for the relief of swelling in seven cases, in one of which no fluid was obtained. In one case fifty successful aspirations were done. In another case aspirations were done twice weekly for several months. The character of the fluid varied from a clear yellow or amber color to a sanguineous or bloody fluid. In one case a high bilirubin content of the aspirated fluid was reported. In a case recently studied by McKenna, the cholesterol content of the fluid was found to be high.

### *Blood Cholesterol*

The blood cholesterol content was determined in only eight of the forty-one cases. In four of these it was higher than normal,—namely, over 200 milligrams per 100 cubic centimeters. In the other four cases the studies showed high normal values. As stated elsewhere in the consideration of pathogenesis, we believe that hypercholesterolaemia is a frequent accompaniment of xanthomatous tumors of the joints, and that blood cholesterol studies would prove valuable if carefully done in all cases.

### *Roentgenographic Examination*

Roentgenographic examination was reported negative in many cases. In other cases it showed the presence of considerable exudate within the joint, distention of the joint capsule, or swelling of the soft parts. Occasionally it revealed the shadow of a soft-tissue tumor. When the joint symptoms had caused long-standing interference with function, roentgenographic examination showed moderate decalcification of the bone structure. Where there had been erosion of the bone from pressure of the tumor, as in the case of the xanthoma in the intercuneiform joint of the foot (Case 3), this bone abnormality was demonstrated.

### *Diagnosis*

Although in none of the cases studied was the diagnosis of xanthomatous tumor made preoperatively, we believe that the symptoms and signs are sufficiently characteristic to permit a diagnosis in many instances if the condition is borne in mind. The presence of an obscure fluid swelling of the knee joint in association with intermittent pain and with mild symptoms of mechanical interference with function is suggestive. The dis-

covery of a soft movable body or tumor on either the inner or the outer aspect of the patella, or above it in the suprapatellar pouch, which can be made to disappear within the joint, is confirmatory. Roentgenographic examination is of value in a negative way by ruling out the presence of a joint mouse, although it frequently will not demonstrate the tumor.

Aspiration, with recovery of an orange, brown, or sanguineous, thick, oily fluid, is very significant, and the demonstration of cholesterol in large amounts in the fluid is pathognomonic of xanthoma. An elevated blood cholesterol also substantiates the diagnosis, although a normal figure by no means excludes it.

In most of the cases operations were performed as the result of a diagnosis of loose body, lipoma, osteochondromatosis, or chronic synovitis. Joint tumor and particularly xanthoma should always be considered in the differential diagnosis of such conditions.

### *Treatment*

The proper treatment of joint xanthoma, in our opinion, is radical extirpation. Since the diagnosis of xanthoma was never made except at operation, radiation was never tried as the primary treatment. It is possible that postoperative radiation may be of some value in preventing local recurrence, but its use in large dosage as the primary method of treatment would almost certainly result in loss of joint function and would offer little hope of causing disappearance of the tumor.

The operation should be performed with the aid of a tourniquet whenever possible. Wide exposure of the joint—in the case of the knee, by a parapatellar incision with reflection of the patella—is necessary to permit complete exploration, without which some small secondary tumor may be overlooked. In the case of a solitary tumor, simple excision, including the pedicle and a wide base of synovial membrane, gives an excellent chance for cure. In the case of multiple tumors, multiple local excisions may be done, or, depending upon their extent, a subtotal or total synovectomy is recommended. If the tumor is of the diffuse type, the synovial membrane should be removed as completely as possible. A good plane of cleavage can be found between the thickened synovial membrane and the underlying structures, and all of the suprapatellar pouch and the lateral expansions of the membrane over the condyles should be dissected out down to and including both menisci and the infrapatellar fat pad. If there is tumor formation in the intercondylar notch, the synovial membrane should be trimmed away in this region also.

In the surgical removal of xanthomatous tumors in the past, the operators have erred by being too conservative, especially in the multiple and diffuse types. Hartman's patient was subjected to three operations before cure was obtained by total synovectomy. In Largiadèr's case two local operations were required, and this was also true of Case 4 in our series in which, at the second operation, it was also considered necessary to excise the patella. These results may be compared with that of Case 1 in



FIG. 1

Case 1. Photograph of drawing of synovial-membrane specimen (about two-ninths actual size) showing diffuse xanthomatosis associated with chronic hemorrhagic villous arthritis.

our series, an example of very extensive involvement by the diffuse type of tumor, where a complete and radical synovectomy (the extent of which may be seen from the specimen shown in Figure 1) effected a complete cure. While as extensive an operation as this is likely to be followed by some loss of joint function, most patients will retain a range of nearly 90 degrees of flexion from a position of complete extension, which is sufficient for ordinary needs.

### *Recurrence*

Recurrence of the tumor took place in seven of the forty-one cases. The follow-up period was too short in many instances to exclude the possibility of late recurrence. The earliest recurrence took place in four months and was in one of our cases (Case 4). The latest recurrence was after eight years, also in one of our cases (Case 8).

Recurrences are due, in all probability, either to the later development of a small tumor undiscovered at the time of operation or to inadequate removal of the primary tumor. We cannot exclude the possibility that the same set of conditions, which caused the development of the original tumor may not again operate at a later time to cause the formation of another tumor.

One important fact needs particular emphasis—namely, *no instance of a benign giant-cell xanthoma undergoing malignant transformation has ever been reported.*

### XANTHOMATA AND GIANT-CELL TUMORS OF SYNOVIAL MEMBRANE

Among the descriptions of intra-articular tumors found in the literature are references to giant-cell tumors and xanthomata of synovial membrane. The pathological description of these two tumors differs solely in one respect,—namely, the presence or absence of a cell referred to as

"foam cell", "xanthoma cell", or "lipoid cell". This is a fairly large polyhedral cell, varying from twenty to forty microns, with a small central, usually pyknotic, nucleus and a translucent foamy cytoplasm. In unstained frozen sections, doubly refractile lipid may be identified in variable quantities, and, by methods of chemical extraction, cholesterol or its esters may be readily isolated from the tumor material. Most authors are convinced that it is a cell of the reticulo-endothelial system, and with that view the authors are in thorough agreement. There is considerable doubt, however, that two distinct intra-articular tumors, identical in all other clinical and pathological respects, really exist. The presence of lipid can be excluded only by a thorough investigation of the tumor, including fat stains, chemical extraction, and polariscopic examination. Frequently, a routine hematoxylin and eosin stain will reveal no lipid, whereas a fat stain or a polariscopic examination will reveal its presence in great abundance. In two of our cases where lipid cells were previously overlooked, they were discovered on reexamination of old material, and, until the presence of foam cells is excluded by the methods described, it seems preferable to consider that all intra-articular giant-cell tumors of synovial membrane are xanthomata. We have seen two examples of extra-articular tumors of synovial membrane originating from the posterior capsule of the knee joint in which no lipid could be demonstrated by the methods described, but this tumor should not be confused with the intra-articular xanthoma, as it may have an entirely different significance, and is probably a variety of synovioma.

#### HISTOLOGY

The histology of joint xanthomata includes a description of the alterations in the underlying synovial membrane, since it is there that the earlier changes may be seen. This seems to have been previously overlooked, and its importance is of essential significance in reaching an understanding of the pathogenesis of the tumor.

If one examines the circumscribed tumor from a case of xanthoma, one finds a surface covering of flattened synovial-membrane mesothelium overlying a tumor in which the following elements can be identified:

1. *Foam cells:* These are large rectangular or polyhedral cells, usually with a small central pyknotic nucleus and a transparent foamy cytoplasm—whence the name. In hematoxylin-eosin sections, the cytoplasm has been removed by the various lipid solvents employed. In the technique with sudan III, the foam cells are seen to be sudanophilic and are often more numerous than they appear in hematoxylin-eosin sections. By examination of unstained frozen sections with the polariscope, doubly refractile lipid may be demonstrated, and by chemical extraction, as was done by Hartman and others, cholesterol or its esters may be obtained.

2. *Fibrocellular stroma:* The groundwork of the process is a fibrocellular stroma, in places highly fibrous, but for the most part moderately

cellular. The basic cell is a short, blunt spindle cell with a pale, slightly elongated nucleus, somewhat like a fibroblast and yet more allied to an endothelial cell or to the cells found lining the surface mesothelium. With careful study, aided by fat stains, one notes various stages of transition of these so-called "stroma cells" into the much larger "foam cells". One may even observe tiny globules of fat in the stroma cells, so that from microscopic analysis it becomes evident that the foam cells are merely stroma cells laden with cholesterol.

3. *Blood vessels*: Principally in the form of small capillaries, they are a conspicuous feature of the process, and they usually lie in direct apposition to both stroma and foam cells.

4. *Blood pigment*: This is present as coarse yellow or brown particles of hemosiderin, liberally scattered through the groundwork, usually in relationship to a small capillary and principally intracellular, although occasionally extracellular in location. When intracellular, these particles may lodge within either stroma or foam cells, another feature which seems to identify these two apparently dissimilar elements.

5. *Multinucleated giant cells*: These cells are numerous although their number varies in different fields and in different cases. In some cases from five to ten nuclei are present, whereas in other cases from twenty to forty nuclei are the rule, and the resemblance to epulis giant cells, such as those seen in giant-cell tumor of bone, is striking. The nuclei of the giant cells and those of the stroma cells are so similar that in all probability the former are derived from the latter. The stroma cell would thus appear to be a versatile element capable of: (a) differentiation into a foam cell, (b) phagocytosing blood pigment, and (c) becoming transformed into a giant cell. This versatility of functions is a property of the reticulo-endothelial cell, and, in this connection, it is interesting that in various forms of systemic xanthomatosis foam cells, identical with those seen in joint xanthomata, are generally regarded as being of reticulo-endothelial origin (Plewes).

The synovial membrane in areas not containing localized tumor shows exaggeration and hypervascularization of the villous folds, together with a striking deposition of coarse clusters of hemosiderin within and beneath the mesothelial layer. There is also a proliferation of the surface mesothelial cells which are identical with the so-called stroma cells. The latter are probably derived from the synovial-membrane lining. This would correspond closely to the descriptions of hemorrhagic villous arthritis in the literature (Kling and Sashin, and Koch), and would indicate phagocytic properties of the mesothelial lining and a close relationship to the reticulo-endothelial system. This same relationship has been found in other mesothelial cells lining serous cavities.

#### PATHOGENESIS

From a consideration of the foregoing, it is possible to reconstruct with some semblance of plausibility the dynamics of the process resulting



in the fully developed tumor. Since the non-tumorous areas are in all probability the more recently affected ones, we may assume that the earliest changes consist in a proliferation of lining mesothelial cells and an overgrowth of small capillaries. Hemorrhages take place from the numerous newly formed blood vessels. In all probability there is an intracellular formation of cholesterol and hemosiderin as decomposition products of hemoglobin: the former results in the transformation of stroma cells into foam cells; the latter, of stroma cells into pigmented cells. The recovery of both bilirubin and cholesterol from the joint fluid in cases of xanthoma further substantiates this belief. Chemically, moreover, bilirubin and hemosiderin are closely allied. We are not unaware that this simple description fails to explain several features,—notably why intracellular cholesterol develops in this reaction and not in other hemorrhagic-tissue reactions.

Most explanations of xanthomatosis assume that a primary systemic hypercholesterolaemia results in local deposition of cholesterol, since hypercholesterolaemia is a frequent humoral accompaniment of this condition. The explanation which we have offered assumes that both the local cholesterol formation and the systemic hypercholesterolaemia are expressions of a common underlying disturbance of lipid metabolism.

#### RELATION TO SYSTEMIC DISEASE

The reader is undoubtedly familiar with other forms of xanthomatosis and is likely to wonder whether any relationship exists between joint xanthomata and other forms of systemic xanthomatosis. At the onset it may be stated that, while many of the cases of joint xanthomata are associated with hypercholesterolaemia, no coincidence of joint xanthoma with systemic forms of xanthomatosis exists. Rowland distinguishes:

A. Essential xanthomatosis:

1. A variety involving skin and mucous membranes, tendon sheaths, and viscera;
2. Niemann-Pick disease;
3. Hand-Christian-Schüller syndrome;
4. Gaucher's disease.

B. Symptomatic or secondary xanthomatosis. This is seen as cutaneous or visceral manifestations in diseases of the liver and kidney, associated with hypercholesterolaemia, and in diabetic lipaemia. The disappearance of cutaneous xanthomatous tumors has often followed the restoration of the blood cholesterol to normal. This is usually accomplished by low-fat diets. An excellent review of the entire subject of xanthomatosis is that of Gruenfeld and Seelig. Among other facts, they point out that Virchow drew a parallel between xanthomatosis and arteriosclerosis, was specific about the transformation of fibroblasts into foam cells, and traced every stage of transition. Lubarsch found lipid

in endothelial cells of blood and lymph spaces and in fibroblasts, and traced xanthoma cells to lymph endothelium.

Some controversy exists as to the nature and origin of the xanthoma cell and the relation of cholesterol metabolism to various forms of xanthomatosis. Hypercholesterolaemia is not universally observed either in the joint form or in other forms of xanthomatosis. Chvostek believed that chemical changes in the cells were more important than cholesterolaemia. Abrikossoff and Herzenberg believed that the cholesterolaemia is universally due to liver damage. Biedermann and Höfer attempted to settle the question of origin of xanthoma cells by methods of tissue culture, employing marrow from patients with the Hand-Christian-Sehüller syndrome. Cells developed into typical foam cells, and these authors believed that they developed from reticulo-endothelium. Cholesterolaeic serum was used in the culture medium. Fibroblasts in the same medium did not develop into foam cells.

Plewes studied eighteen cases of xanthoma, in which the nodules were removed surgically, to determine if possible the nature and origin of the xanthoma cells. He concluded: that the xanthoma cell and the foam cell of atheroma are identical; that the origin of both these cells is from the reticulo-endothelial system; that the foam cells are evidence of specific reaction of cells of the reticulo-endothelial system to certain lipoids, especially cholesterol and its esters, when conditions in the tissue are favorable for their deposition.

The preponderance of evidence thus favors the conclusion that the foam cell is a modified cell of the reticulo-endothelial system; also that in cases of joint xanthoma the foam cell is probably derived from a synovial-membrane mesothelial cell, which is also related to the reticulo-endothelial system.

#### PATHOLOGICAL CASE REPORTS

CASE 1. A male, aged twenty-seven, with diffuse xanthomatosis of the right knee joint, was first seen in September 1935.

##### *History*

The patient stated that the right knee had been injured in 1926 and 1927. In 1929 the knee had begun to swell and there had been intermittent swelling every two or three weeks since that time. The patient had had vaccine and other treatment for chronic arthritis.

##### *Examination*

Swelling of the right knee and wasting of the muscles of the thigh were noted. There were small movable bodies lateral and medial to the patella. Free fluid was present in the joint. Flexion and extension were limited. No tenderness was elicited.

##### *Roentgenographic Examination*

Roentgenograms showed decalcification of the bones of the knee joint and the femoral condyles and considerable exudate in the suprapatellar pouch.

##### *Preoperative Diagnosis*

The preoperative diagnosis was "osteochondromatosis of the right knee".

### Operation

On September 10, 1935, arthrotomy and total synovectomy were performed.

### Laboratory Findings

September 14, 1935—Blood cholesterol: 266 milligrams per 100 cubic centimeters

October 29, 1935—Basal metabolic rate: -18

November 30, 1936—Blood cholesterol: 310 milligrams per 100 cubic centimeters

November 30, 1936—Basal metabolic rate: -11

### Follow-Up

There has been no recurrence to date. Function is good.

### Pathological Report

**Macroscopic:** "The specimen is the synovial membrane of the knee joint with attached semilunar cartilage. The synovial membrane has been removed in one piece, is orange in color, and is greatly thickened, averaging from five-tenths to one centimeter. Its lining is considerably wrinkled, and from it arise numerous papillary polyhedral excrescences. Some of these are the size of a millet seed, but others are one centimeter in diameter. The villous folds are greatly exaggerated."

**Microscopic:** "There is a surface lining of flattened synovial membrane beneath which are revealed the following changes:

1. There are large sheets of translucent polyhedral cells with foamy cytoplasm about the size of fat cells with a small central pyknotic nucleus arranged in coherent masses.

2. The bulk of the tumor is composed of a highly cellular mixture of mesothelial cells. These are fairly large with pale vesicular nuclei and finely granular cytoplasm. These cells may be seen undergoing a transition into the larger foam cells, with many containing small vacuoles, presumably lipid material. They are grouped around blood vessels, which are plentiful in the field. The vacuoles are sudanophilic with fat stains.

3. Numerous areas show scattered deposits of intracellular hemosiderin pigment.

These are especially abundant beneath the synovial membrane.

4. Around the clumps of pigment are foreign-body giant cells."

**Diagnosis:** "Diffuse xanthomatosis of synovial membrane."

**CASE 2.\*** A female, aged twenty-three, with a solitary xanthoma of the prepatellar pouch, was first seen on April 27, 1929 by Dr. T. C. Thompson.

### History

The patient stated that the right knee cap had been struck in September 1926, and she had had intermittent pain and swelling ever since. There had been occasional locking. At aspiration, on April 28, 1929, fifty cubic centimeters of sterile dark amber fluid was obtained.

\* From the Orthopaedic Service, Johns Hopkins Hospital.



FIG. 2

Case 1. Roentgenogram showing exudate and calcification of the femoral condyles and soft-tissue shadow in popliteal space.

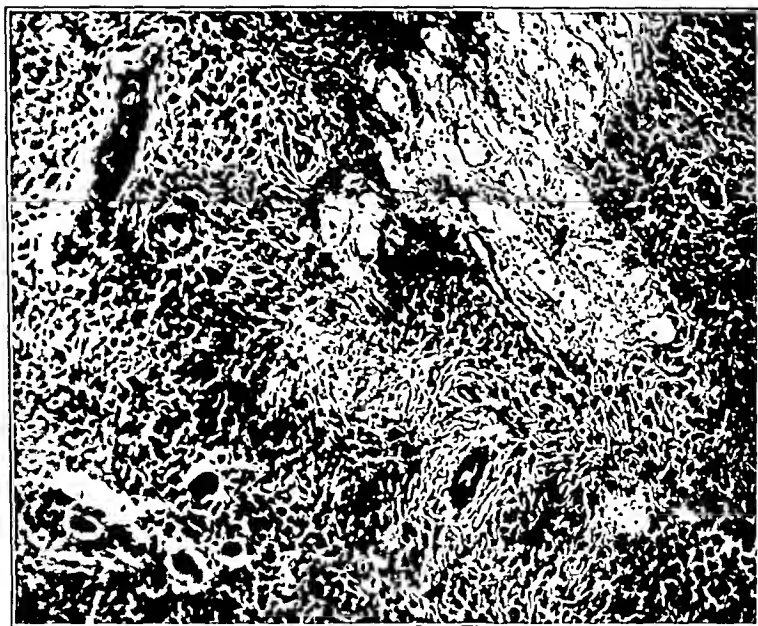


FIG. 4

Case 1. Photomicrograph ( $\times 1110$ ) of one of the tumors. Note the foam cells, fibrocellular stroma, and multinucleated giant cells.

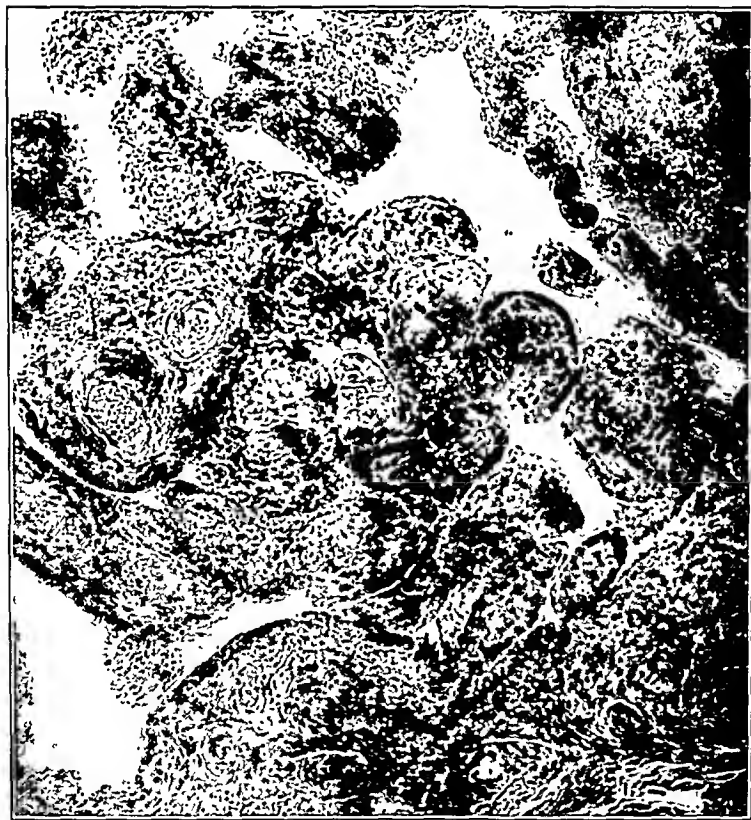


FIG. 3

Photomicrograph ( $\times 1110$ ) of an area of chronic hemorrhagic villous arthritis.

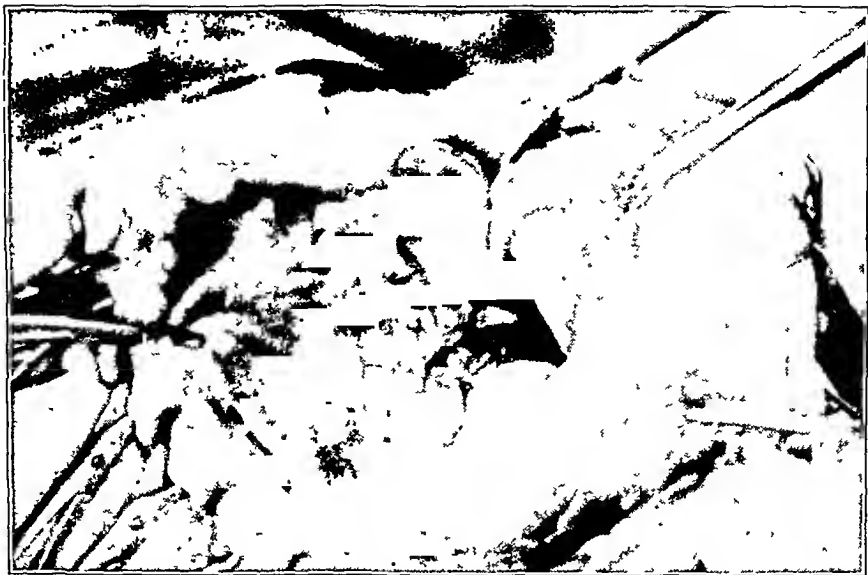


FIG. 5

Case 2. Photograph of operation (one-third actual size). Notice the tumor *in situ* in the suprapatellar pouch.



FIG. 6

Case 2. Roentgenogram reported negative, but showing soft-part shadow in infrapatellar region.

patella in the quadriciceps pouch, arising from the posterior synovial membrane and quite firmly attached to the anterior surface of the femur just above the condyle. The tumor measured approximately five by three by two centimeters."

#### *Examination*

The right knee was slightly larger than the left. After aspiration, a movable body was palpated just above and lateral to the patella. Flexion and extension were only slightly restricted.

#### *Roentgenographic Examination*

Roentgenograms were negative.

#### *Preoperative Diagnosis*

The preoperative diagnosis was "loose body".

#### *Operation*

On June 6, 1929, the tumor was excised, and the synovial membrane of the suprapatellar pouch was resected.

#### *Follow-Up*

On August 17, 1929, the right knee was slightly larger than the left. Function was good. Flexion to 80 degrees was possible, and there was complete extension. There was no recurrence to 1938.

#### *Pathological Report*

*Macroscopic:* "A large soft tumor mass, consisting of numerous finger-like projections, was found just above the

*Microscopic:* "Examination showed a typical xanthomatous giant-cell tumor, similar to the above. Both foam cells and giant cells were especially numerous."

*Diagnosis:* "Xanthoma."

**CASE 3.\*** A male, aged thirty-seven, with a solitary pedunculated xanthoma of the right navicular-cuneiform joint, was first seen on December 15, 1937 in the surgical clinic of the French Hospital.

#### *History*

There had been a painless lump on the dorsum of the right foot of one year's duration. There was no history of trauma.

#### *Examination*

Examination was negative except for a blood pressure of 150/96. There was a firm movable mass, two inches in diameter, over the dorsum of the right foot, which was not attached to the tendons.

#### *Laboratory Findings*

Urinalysis, blood count, and blood chemistry were normal. The blood cholesterol was 170 milligrams per 100 cubic centimeters.

#### *Roentgenographic Examination*

Roentgenograms showed a shadow in the soft parts and a cystic area on the second right cuneiform.

#### *Preoperative Diagnosis*

The preoperative diagnosis was "lipoma".

#### *Operation*

The tumor arising from the synovial membrane, between the navicular and the second cuneiform, was excised.

#### *Follow-Up*

There has been no recurrence to date.

#### *Pathological Report*

*Macroscopic:* "The specimen consists of an

\* Courtesy of Dr. Arthur Wright.

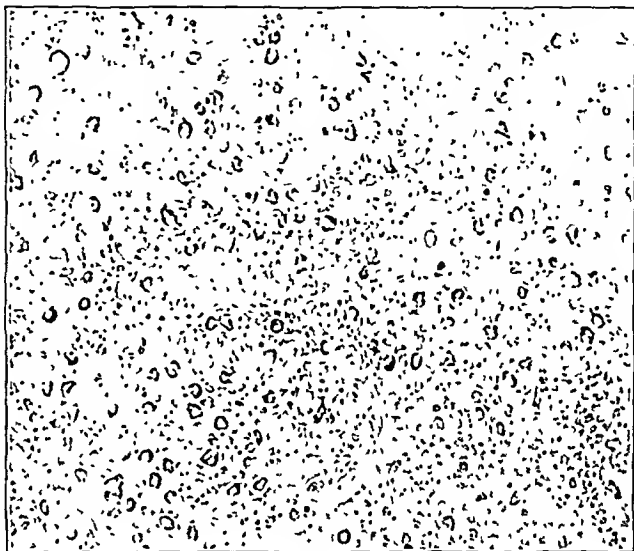


FIG. 7

Photomicrograph ( $\times 100$ ) showing an area of giant cells and numerous endothelial phagocytes containing hemosiderin.

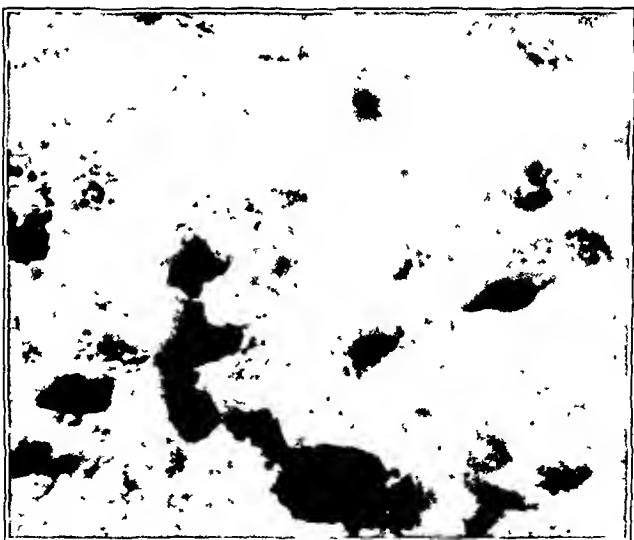


FIG. 8

High-power photomicrograph ( $\times 400$ ) of area shown in Fig. 7.



FIG. 9

Case 3. Roentgenogram showing position of tumor and rarefaction of the underlying second right cuneiform bone.



FIG. 10

Case 3. Photograph of drawing showing actual size of gross specimen.

encapsulated irregular lobulated tumor, one and one-half inches by one inch, which on section has a yellow chalky appearance, grossly suggesting a giant-cell xanthoma."

*Microscopic:* "Sections show a tumor mass, composed principally of polyhedral endothelial-like cells, dense fibrous stroma, dense bands of interstitial fibrous tissue, scattered deposits of interstitial and intracellular hemosiderin pigment and numerous giant cells and occasional clusters of foam cells, which are large and polyhedral in shape. Many foam cells contain intracellular hemosiderin pigment. This histological composite is characteristic of giant-cell xanthoma of the synovial membrane of the joints. Fat stains revealed many more foam cells than could be seen in the hematoxylin-eosin preparations. Many fine fat deposits were found in the endothelial stroma cells. All stages of transition of stroma cell to foam cell could be traced."

*Diagnosis:* "Giant-cell xanthoma of articular synovial membrane."

CASE 4.\* A female, aged sixteen, with a solitary pedunculated xanthoma of the left knee, was first seen in October 1933.

#### History

The patient gave a history of pain in the left knee of six months' duration. The onset of the pain had occurred after gymnastic work, and the injury was believed to be a sprain.

\* Courtesy of Dr. Bradley L. Coley.

### Examination

A firm, freely movable mass, the size of a lima bean, was palpated mesial to the patella. This mass disappeared with extrusion. There was slight limitation of extension. No swelling was present.

### Röntgenographic Examination

Roentgenograms were negative.

### Preoperative Diagnosis

The preoperative diagnosis was "loose body".

### Operation

In November 1933, the tumor attached to the fat pad was excised.

### Follow-Up

The patient was readmitted in February 1934, because of a recurrence of the tumor. The patella and the tumor were excised, and the patient was given a course of deep x-ray therapy.

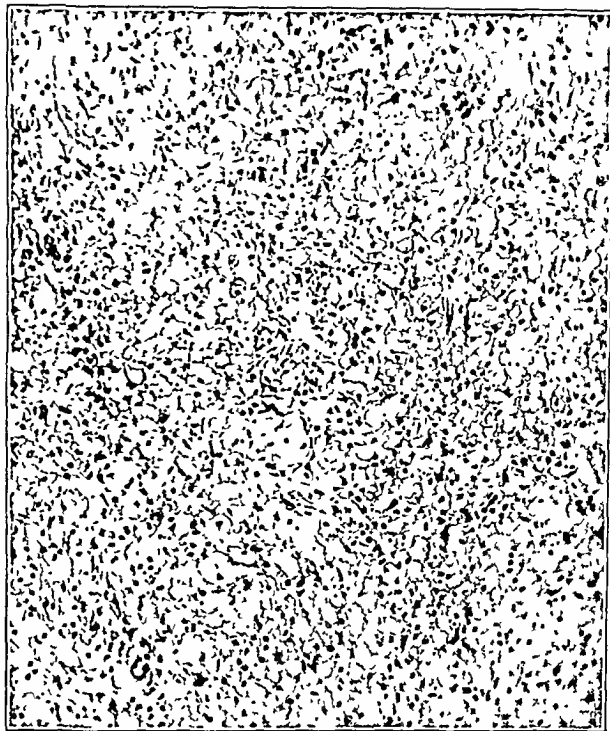


FIG. 11

Case 3. Photomicrograph ( $\times 100$ ) showing large collection of xanthoma cells.

There has been no recurrence to date.

### Pathological Report

**Macroscopic:** "The specimen consists of an oval-shaped mass, three by one and five-tenths centimeters in diameter. The tissue is soft in consistency. On section, there is one area of hard fibrous tissue in the center."

**Microscopic:** "Sections show a cellular mass of undifferentiated connective-tissue cells that are somewhat of the long spindle type. Scattered throughout this cellular mass are many large giant cells of the epulis type."

**Diagnosis:** "Fibrosarcoma (epulis type)."

### Pathological Report (February 13, 1934)

**Macroscopic:** "The specimen consists of a patella and synovial membrane. Immediately to one side of the patella there is a small circumscribed encapsulated growth about one centimeter in diameter. This is attached to the synovial membrane by a rather broad pedicle."

**Microscopic:** "Sections from the synovial-membrane tumor show a diffusely infiltrating mass of undifferentiated connective-tissue cells, somewhat of the short spindle type. Scattered through this mass there are a few moderately large giant cells, with an average of from eight to ten nuclei. Sections from tissue adjacent to the base of the tumor show it to be invaded by a similar tumor growth."

**Diagnosis:** "Fibrosarcoma."

On reviewing these sections, small clusters of foam cells were found, establishing the diagnosis of xanthomatous giant-cell tumor.

CASE 5.\* A male, aged thirty-seven, with a solitary pedunculated xanthoma of the

\* Courtesy of Dr. V. S. Johnson.



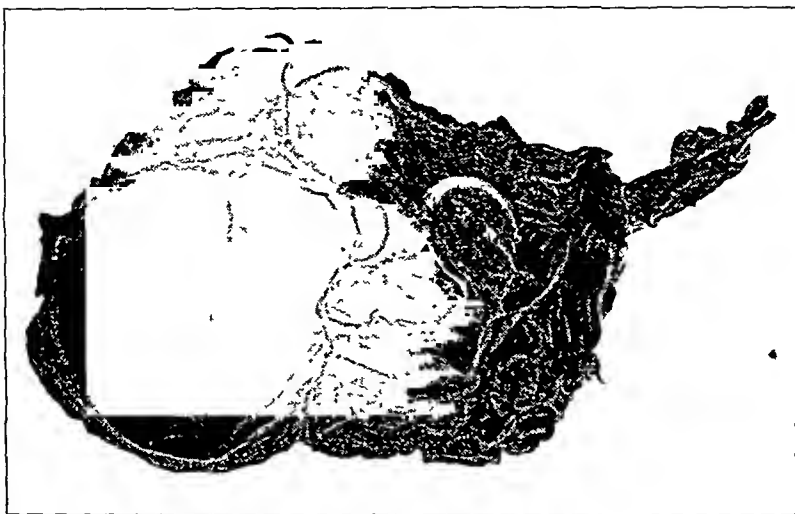


FIG. 12

Case 4. Photograph of drawing showing actual size of specimen of recurrent pedunculated xanthoma. The patella has been excised.



FIG. 13

Case 5. Photograph of drawing showing actual size of gross specimen.

right knee, springing from the medial meniscus, was first seen on October 20, 1937.

#### *History*

The patient stated that on the day before admission, while crouching, the right leg had slipped. He had experienced sudden sharp pain in the right knee and had been unable to flex the knee without pain.

#### *Examination*

There was swelling of the knee, with effusion. Motion was restricted by pain. A firm, freely movable mass, one-half an inch in diameter, could be palpated on the medial aspect of the patella. This could be reduced into the joint.

#### *Roentgenographic Examination*

Roentgenograms were negative.

#### *Laboratory Findings*

The blood cholesterol was 190 milligrams per 100 cubic centimeters.

*Preoperative Diagnosis*

The preoperative diagnosis was "loose body".

*Operation*

On October 21, 1937, the medial meniscus with the attached pedunculated tumor was excised.

*Follow-Up*

There has been no recurrence. Motion is limited by 10 per cent.

*Pathological Report*

*Macroscopic:* "The semilunar cartilage of the knee joint is present in two pieces, which fit perfectly. Originating from the outer convex border, there is a pedunculated tumor, one and five-tenths centimeters in diameter, which has a basic yellow color, tinged with some bright-red mottling."

*Microscopic:* "Sections, which include the entire tumor mass and the semilunar cartilage, show a fibrocellular matrix in which are scattered areas of coarse hemosiderin pigment, areas containing giant cells with from four to twenty nuclei, the larger ones being indistinguishable from epulis giant cells, and areas containing polyhedral foam or xanthoma cells. The synovial-membrane surface shows slight exaggeration of the folds and slight round-cell infiltration. The semilunar cartilage is not involved."

*Diagnosis:* "Benign giant-cell xanthoma of synovial-membrane."

CASE 6.\* A male, aged twenty-eight, with multiple xanthomata of the left knee joint, was first seen on January 3, 1931.

*History*

The left knee had been injured ten years previously while playing football. The knee had been immobilized in plaster for eight weeks. The patient complained of intermittent pain, stiffness, and swelling of six years' duration. There had been repeated locking.

*Examination*

Considerable effusion was present in the left knee joint. The patella was floating. Flexion was slightly limited. Moderate tenderness about the lateral meniscus was noted. There was no palpable tumor.

*Roentgenographic Examination*

Roentgenograms showed marked distention of the joint capsule.

*Preoperative Diagnosis*

The preoperative diagnosis was "internal derangement of the left knee of an obscure type".

\* Courtesy of Dr. George E. Bennett, Baltimore, Maryland.



FIG. 14

CASE 5. Photomicrograph ( $\times 100$ ) showing numerous xanthoma cells.

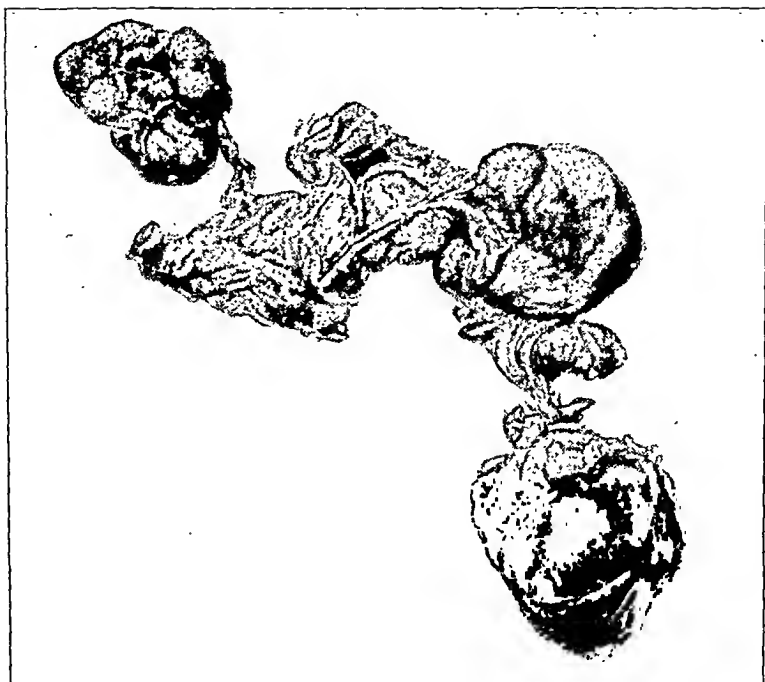


FIG. 15

Case 6. Photograph of drawing showing actual size of multiple xanthomata.

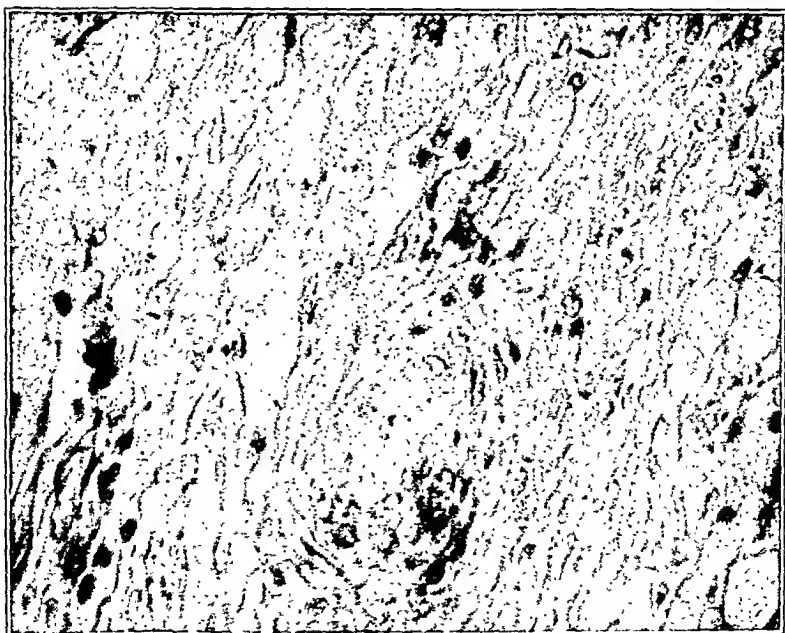


FIG. 16

Photomicrograph ( $\times 300$ ) showing detail of xanthoma cells.

### Operation

On March 9, 1931, the tumors were excised and the synovial membrane was resected.

### Follow-Up

There has been no recurrence of the tumor, and the patient has been perfectly well to date.

### Pathological Report

**Macroscopic:** "The specimen is a rounded tumor, measuring one and five-tenths centimeters in diameter. The basic color is orange yellow, and the surface is smooth and rounded. There is a separate piece of synovial membrane, about two centimeters square, which likewise has a golden-orange color, and attached to this is a separate polypoid tumor with a separate pedicle, one centimeter long. A third pedunculated tumor of the same size is also present. It lies free, but undoubtedly has been detached from the synovial membrane."

**Microscopic:** "Examination of sections from a small tumor shows a groundwork of fibrocellular tissue in which are scattered nests of large pigmented cells containing intracellular hemosiderin. Small giant cells of the foreign-body type are present in the pigmented areas. In addition, sheets of polyhedral foam cells are present, sometimes in large numbers. An area from the synovial membrane shows marked hypervascularity, together with clumps of intracellular blood pigment and occasional xanthoma cells."

**Diagnosis:** "Xanthomatous giant-cell tumor of the synovial membrane."

**CASE 7.\*** A female, aged eighteen, with a solitary pedunculated xanthoma of the left knee, showing acute hemorrhage from torsion or constriction of the pedicle, was first seen on March 1, 1938.

### History

The patient stated that she had had "rheumatism" intermittently of three years' duration. On February 26, 1938, when attempting to rise from her knees while scrubbing a floor, the left knee had locked and the patient had suffered exquisite pain. She had experienced a clicking sensation inside the knee.



FIG. 17

Case 7. Photograph of drawing showing actual size of hemorrhagic pedunculated xanthoma.

She had experienced a clicking sensation inside the knee.

### Examination

There was tenderness over the inner aspect of the patella. Slight swelling of the knee was noted. Extension was limited to 160 degrees.

### Röntgenographic Examination

Roentgenograms were negative.

### Laboratory Findings

The blood cholesterol was 222 milligrams per 100 cubic centimeters.

### Preoperative Diagnosis

The preoperative diagnosis was "joint mouse".

### Operation

At operation a thick orange fluid was found in the joint. A bluish pedunculated tumor was excised from the infrapatellar fat pad.

\* Courtesy of Dr. Toufick Nicola.

*Follow-Up*

There has been no recurrence. Function is good.

*Pathological Report*

**Macroscopic:** "The specimen consists of a small pedunculated tumor, measuring two by five-tenths of a centimeter. The pedicle is about one centimeter in length. On section, it is soft and hemorrhagic in consistency."

**Microscopic:** "Examination shows a pedunculated tumor, covered by a thin fibrous capsule. The central portion of this tumor is the site of extensive recent hemorrhage and of numerous congested blood vessels, giving it at first glance an angiomatous appearance. In the stroma there are multinucleated giant cells with about six nuclei and also short spindle cells of fibroblastic character. In addition, there are some polymorphonuclear-cell infiltration and scattered small deposits of intranuclear hemosiderin pigment. Finally there are definite foam or xanthoma cells in considerable numbers, although not as distinct as those seen in other cases. They are further demonstrated in sections stained for fat by the sudan III method. There is no doubt that this is a pedunculated xanthoma, and the extensive hemorrhage and vascular congestion are probably the result of constriction or torsion of its pedicle."

**Diagnosis:** "Pedunculated xanthomatous giant-cell tumor, showing hemorrhage, congestion, and polymorphonuclear infiltration."

**CASE 8.\*** A female, aged fifteen, with a xanthoma of the right ankle joint, was first seen in February 1929.

*History*

The patient gave a history of pain and swelling on the anterior surface of the right ankle of six years' duration. She had been treated for synovitis.



FIG. 18

Case 8. Photograph of drawing showing cross-section of tumor (actual size).

*Examination*

A semisolid movable tumor was palpable under the anterior surface of the right ankle.

*Roentgenographic Examination*

Roentgenograms showed a soft tumor mass.

*Preoperative Diagnosis*

The preoperative diagnosis was "fibroma".

*Operation*

In February 1929 an arthrotomy was performed, and the tumor was excised.

*Follow-Up*

There was a recurrence in 1936, but the patient refused operation and left the country.

*Pathological Report*

**Macroscopic:** "The specimen was a tumor which measured six by three by two centimeters and was attached to the synovial membrane of the ankle joint. It was smooth, encapsulated, and kidney-shaped, and was tinged brown and yellow. To the touch, it was as solid as kidney tissue."

**Microscopic:** "Sections of the original tissue recently prepared show a groundwork of fibrous connective tissue, in which are liberally scattered masses of intracellular hemosiderin pigment, large sheets of foam or xanthoma cells, and proliferating small endothe-

\* This case was previously reported by Dr. Lewis Clark Wagner in *Annals of Surgery*, XCI, 421, 1930.

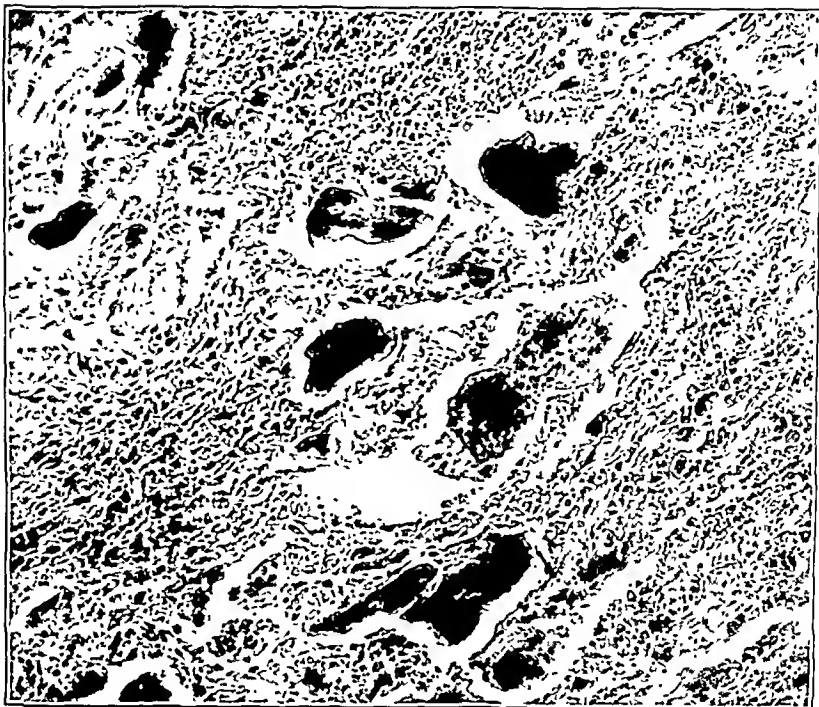


FIG. 19

Low-power photomicrograph showing an area abundant in giant cells and pigmented macrophages containing hemosiderin. Numerous xanthoma cells are present in other microscopic fields.

lial-like cells. The giant cells contain anywhere from fifteen to twenty nuclei. The tumor is moderately vascular, being liberally supplied by small capillaries and large blood vessels. In spite of the age of the tissue, preparation is most satisfactory, and the appearance is pathognomonic of giant-cell xanthoma of the synovial membrane."

*Diagnosis:* "Giant-cell xanthoma of the tibiotarsal joint."

**CASE 9.** A male, aged fifty, with a solitary xanthoma of the right knee, was first seen on November 16, 1931 by Dr. P. D. Wilson.

#### *History*

There was a history of pain and swelling of the right knee of three months' duration. The patient had difficulty in walking and in standing, due to instability of the knee joint.

#### *Examination*

The right knee showed definite swelling, and there was free fluid with considerable distention of the suprapatellar pouch. A bulge was present at the lateral aspect of the knee above the patella. A movable body was palpable in the suprapatellar pouch.



FIG. 20

Case 9. Photograph showing five-sixths actual size of tumor.

*Roentgenographic Examination*

Roentgenograms were negative.

*Preoperative Diagnosis*

The preoperative diagnosis was "loose body".

*Operation*

On November 19, 1931, the right knee was explored, and the tumor was removed. The patient was discharged in good condition on November 28, 1931.

*Follow-Up*

The patient was seen in October 1938. Function of the knee was good, and there had been no recurrence.

*Pathological Report*

*Macroscopic:* "Just lateral to the patella on the outer aspect of the knee joint is a curious pedunculated tumor arising from the synovial membrane close to the edge. The tumor consists of numerous small tabs, firm in consistency and showing evidence of congestion. The specimen consists of eight pieces of tissue, one of which measured five by two centimeters by three-tenths of a centimeter and was covered by synovial membrane on one side. The second specimen, similar to the first, measured two and five-tenths by two centimeters. Several smaller masses were also removed."

*Microscopic:* The original microscopic diagnosis was "pannus necrosis and acute inflammation". The senior author (P. D. W.) felt that this case was certainly a xanthomatous giant-cell tumor.

A review of the old slides showed necrotic connective tissue. However, foam cells and giant cells were identified in sufficient number to establish the diagnosis of xanthomatous giant-cell tumor.

#### SUMMARY AND CONCLUSIONS

1. Xanthomata of the synovial membrane of the joints are probably more common than has been hitherto supposed, as is exemplified by this group of nine cases collected over a brief period of time.
2. The preoperative diagnosis of joint xanthoma seems never to have been made. Obscure intermittent swelling of the knee joint—associated with pain and free fluid, occasional locking, and a movable tumor, usually medial to the patella—will frequently be found to be caused by xanthoma.
3. Aspiration of the joint with the recovery of dark or sanguineous fluid points to the presence of tumor. The demonstration of a large amount of cholesterol in the fluid is probably pathognomonic of xanthoma.
4. Xanthomata originate in chronic hemorrhagic villous arthritis.
5. The stroma cell is related to the reticulo-endothelial system. It is derived from the surface synovial-membrane mesothelium, which has reticulo-endothelial properties, and gives rise to: (a) the foam cell, (b) the giant cell, and (c) the pigmented cells found in xanthomatous tumors.
6. Joint xanthomata are related to some fundamental disturbance of lipid metabolism. The blood cholesterol is frequently elevated.
7. Cholesterol formation probably takes place locally as a result of interstitial hemorrhage and is a decomposition product of hemoglobin. Its failure to be formed universally when interstitial hemorrhage occurs is

partially explained by the systemic disturbance of lipid metabolism which usually exists.

8. Joint xanthomata can be cured by radical excision. In the case of solitary tumors, local excision is sufficient, but, in the case of multiple or diffuse xanthomata, a subtotal or total synovectomy is usually necessary.

9. No instance of a benign giant-cell xanthoma undergoing malignant transformation was found.

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# NEPHROLITHIASIS OCCURRING IN RECUMBENCY \*

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## INTRODUCTION

Bastion, in 1861, and Arnozan, in 1886, were the first to report the formation of renal calculi following a period of recumbency. Since then it has been the subject of discussion from time to time, and a survey of the literature has revealed 124 cases, an analysis of which follows:

<i>Primary Condition Necessitating Recumbency</i>	<i>No. of Cases</i>
Tuberculosis of spine . . . . .	27
Tuberculosis of hip . . . . .	24
Fracture of femur (not all proved calculi) . . . . .	23
Osteomyelitis . . . . .	17
Fractures of spine and pelvis . . . . .	14
Other fractures (including 2 osteotomies) . . . . .	5
Arthritis of knee and hip (unclassified) . . . . .	3
Pseudocoxalgia . . . . .	1
Miscellaneous . . . . .	10

The average period of recumbency (where stated) before calculi were discovered was ten months. Analysis of the stones (where stated) revealed phosphate in fourteen cases and oxalate in two.

<i>Conclusion as to Cause (Where Stated)</i>	<i>No. of Observers</i>
Immobilization in recumbency . . . . .	8
Hematuria, the result of vasomotor dysfunction . . . . .	1
Excessive irradiation . . . . .	1
Chronic bone disease . . . . .	2
Focal sepsis . . . . .	1

The author has had the opportunity of studying sixty cases of nephrolithiasis occurring in recumbency. (See Tables I and II.) There were thirty-three males and twenty-seven females. The average age was nineteen years; the oldest patient was fifty-six years of age and the youngest, three and one-half years. The average period of recumbency was nine months; the longest period was five and one-half years and the shortest, five weeks. In estimating the average period, three outstanding time intervals (five and one-half, four, and two and one-half years) were excluded.

## ETIOLOGY

### *Recumbency*

There can be little doubt that stagnation in the renal pelvis is an important factor in the formation of these stones.

\* Presented at the Annual Meeting of the British Orthopaedic Association, Sheffield, England, October 30, 1937.

TABLE I  
SIXTY CASES OF NEPHROLITHIASIS OCCURRING IN RECUMBENCY

Case	Sex	Age (Years)	Disease	Method of Fixation	X-Ray on Admission	Presenting Sign or Symptom	Period of Recumbency Before Discovery	Urinary Infection	Site of Stone	Treatment	Results
1	Male	4	Tuberculosis, T. 7 and 8	Plaster bed	Negative throughout	Hematuria	15 months	No	Left kidney	None	Patient died of diphtheria. Autopsy revealed calculous hydronephrosis.
2	Male	5	Tuberculosis, L. 3, 4, and 5	Jones frame	None taken	X-ray	12 months	Yes	Right kidney	None	Gross hydronephrosis. Calculus still present.
3	Female	21	Tuberculosis, L. 2 and 3 hip	Jones frame	Negative	X-ray	6 months	No	Both kidneys (renal casts)	Patient allowed up 8 months later.	Spontaneous disintegration.
4	Male	25	Tuberculosis, L. 4 and 5	Jones frame	Negative	Hematuria and colic	3 months	No	Both kidneys	None	Natural passage.
5	Male	3½	Tuberculosis, L. 2 and 3	Jones frame	Negative	X-ray	9 months	No	Right kidney	None	Calculi still present.
6	Male	46	Tuberculosis, L. 4 and 5 S. 1 and 2	Jones frame	Negative	X-ray	14 months	No	Left kidney	None	No record.
7	Male	36	Tuberculosis, L. 1 and 2	Jones frame	Negative	X-ray	4 months	No	Right and left upper calices	None	Patient died 15 months later of renal complication.
8	Male	24	Tuberculosis, spine	Plaster bed	Negative	Renal pain and tenderness	21 months	No	Left kidney	Nephrectomy	No further symptoms.
9	Male	5	Tuberculosis, T. 4 and 5	Plaster bed	None taken	Hematuria	5½ months	Yes	Right kidney	Nephrectomy considered but general condition did not permit.	No record.



TABLE I (Continued)

Case	Sex	Age (Years)	Disease	Method of Fixation	X-Ray on Admission	Presenting Sign or Symptom	Period of Recumbency Before Discovery	Urinary Infec- tion	Site of Stone	Treatment	Results
23	Fe- male	4	Tuberculosis, T. 5, 6, and 7	Jones frame	None taken	Pyuria	8 months	Yes	Bladder	None	Natural passage of cal- culi.
24	Fe- male	7	Tuberculosis, L. 2 to 5	Jones frame	Negative	X-ray	12 months	Yes	Left kidney	Nephrectomy	No further symptoms.
25	Fe- male	18	Tuberculosis, T. 5 to 11	Jones frame	Negative	Colic	6 months	No	Left kidney	Ureteral catheteri- zation	Natural passage of one, several calculi still present.
26	Fe- male	30	Tuberculosis, thoracolumbar	Plaster bed	Negative	Colic	5 weeks	Yes	Both kidneys	None	Patient died of renal infection.
27	Male	11	Tuberculosis, right hip	Jones frame	None taken	Hematuria	9 months	Yes	Right kidney	Pyelolithotomy	Patient now up and no further symptoms.
28	Fe- male	10	Tuberculosis, right hip	Jones frame	None taken	Abdominal pain and vomiting	9 months	No	Right kidney (renal cast)	Patient allowed up immediately.	Spontaneous disintegra- tion.
29	Fe- male	5	Tuberculosis, right hip	Jones frame	Negative	X-ray	21 months	No	Right kidney	Patient allowed up immediately.	Partial disappearance.
30	Male	7	Tuberculosis, left hip	Jones frame	None taken	Hematuria	2½ months	Yes	Both kidneys and ureters	Pyelo-uretero- lithotomy	Stone still present in right ureter.
31	Fe- male	4½	Tuberculosis, right hip	Extensions	None taken	Hematuria	10 months	Yes	Both ureters	Ureterolithotomy	No further symptoms.
32	Male	21	Tuberculosis, right hip	Jones frame	None taken	Colic	9 months	No (?)	Both kidneys	Patient allowed up 2 years later.	Bilateral renal calculi.
33	Male	9	Tuberculosis, right hip	Jones frame	Negative	Colic	9 months	No	Both kidneys (renal casts)	Patient allowed up immediately both times.	Spontaneous disintegra- tion in each case.

34	Male	7	Tuberculosis, right hip	Extensions	None taken	Hematuria and colic	11 months	No	Bladder Right renal pelvis and calices	Suprapubic cystostomy Active leg movement in bed	Natural passage. Several stones remain.
35	Male	6	Tuberculosis, left hip	Jones frame	None taken	Hematuria and colic	8 months	No	Not known	None	Natural passage.
36	Male	14	Tuberculosis, left hip	Jones frame	None taken	Hematuria and colic	8 months	No	Right kidney	None	Natural passage and litholapaxy.
37	Male	9	Tuberculosis, left hip	Jones frame	None taken	Simulated appendicular colic	4 months	Yes	Right kidney and ureter	Appendectomy	Natural passage. Calculi still present.
38	Fe-male	9	Tuberculosis, right hip	Jones frame	None taken	Hematuria	4 months	Yes	Both kidneys	None	Calculi still present.
39	Fe-male	19	Tuberculosis, right hip	Extensions Jones frame	None taken	X-ray	2½ years	No	Left ureter	None	? calculi still present.
40	Fe-male	3½	Tuberculosis, right hip	Jones frame	None taken	Hematuria	6 weeks	No	Right kidney	Weekly "turnings"	Too early to estimate.
41	Male	24	Tuberculosis, right hip	Plaster spica Jones frame	None taken	X-ray	2 years	No	Right kidney	Patient allowed up ten months later.	Too early to estimate.
42	Male	16	Tuberculosis, right hip	Jones frame	None taken	Hematuria and colic	17 months	No	Left kidney	Patient allowed up one month later	Calculi are being passed.
43	Fe-male	25	Tuberculosis, right sacro-iliac joint	Jones frame	Negative	X-ray	9 months	No	Right kidney (renal cast)	Patient allowed up two months later.	No record.
44	Fe-male	30	Tuberculosis, right sacro-iliac joint	Jones frame	None taken	Hematuria and colic	6 months	No	Right kidney	Patient allowed up one month later.	Calculi now in ureter.
45	Fe-male	27	Tuberculosis, right sacro-iliac joint	Jones frame	None taken	Colic	18 months	No	Both kidneys	Patient allowed up two months later	Natural passage.
46	Male	25	Tuberculosis, left sacro-iliac joint	Plaster bed	None taken	X-ray	8 months	No	Bladder	Litholapaxy	No record.
47	Male	19	Chronic infectious arthritis	Thomas splints Extensions	None taken	X-ray	8 months	No	Right upper and middle calices	Daily "turnings"	Spontaneous disintegration.

TABLE I (Continued)

Case	Sex	Age (Years)	Disease	Method of Fixation	X-Ray on Admission	Presenting Sign or Symptom	Period of Recumbency Before Discovery	Urinary Infection	Site of Stone	Treatment	Results
48	Male	31	Chronic infectious arthritis	Thomas splints	None taken	Colic	18 months	No	Not known	None	Natural passage.
49	Male	6	Perthes' disease	Jones frame	None taken	Hematuria	3 months	No	Left kidney	Active leg movement 8 months later	Calculi disappeared.
50	Male	7	Perthes' disease	Jones frame	None taken	Hematuria	13 months	No	Right kidney	Active leg movement	No further x-rays.
51	Male	12	Septic arthritis of left hip	Jones frame	None taken	Hematuria	19 months	No	Not known	Active leg movement	Natural passage.
52	Female	21	Poliomyelitis	Thomas splints	None taken	Colic	1 year	No	Left ureter	Increased mobility in bed	Natural passage.
53	Male	6	Poliomyelitis	Jones frame	None taken	Hematuria	19 months	Yes	Both kidneys	None	No record.
54	Female	15	Poliomyelitis	None	None taken	Simulated appendicular colic	1 year	No	Both kidneys	Postural	Too early to estimate.
55	Male	56	Fractured spine (L. 1)	None	None taken	X-ray	4 years	Yes	Both kidneys	None	Patient died two years later, ? cause.
56	Male	26	Fractured spine (L. 1) Fractured femur	Hyper-extension jacket Skeletal traction	Negative	Pyelitis	3 months	Yes	Both kidneys	Left, nephrolithotomy only	Right, calculi still present.
57	Male	23	Closed fracture of tibia and fibula	Plaster casts on leg	None taken	Colic	5 months	Unrecorded	Right kidney	None	No record.
58	Female	28	Osteomyelitis of ilium	Plaster bed	Negative	X-ray	5 months	Yes	Left kidney	None	Patient died of calculous pyonephrosis.
59	Female	38	Old rickets	Plaster casts on leg	Negative	Pyelitis	2 months	Yes	Left kidney	Nephrectomy	No further symptoms.
60	Male	11	Infantile coxa vara	Jones frame	None taken	Hematuria	8 months	No	Right kidney and ureter	None	Calculus still present.

The hilum of the kidney faces forward and inward; in the dorsal decubitus the renal watershed will, therefore, lie at the pelvi-ureteral junction resulting in a tendency for a reservoir to form in the calici-pelvic system. There is consequently more time for salts in a concentrated urine to pass out of solution—salts that would otherwise not have been deposited until the urine was voided. In addition there is a gravitational influence upon any cells or debris, which may cause them to remain as potential stone nuclei.

In its early stages the renal calculus of the ambulatory patient is usually located in the lower calices or pelvis, and is very rarely found in the upper calices; this is probably due to the fact that, in the erect position, the lower calices lie below the outlet of the renal pelvis and are, therefore, less perfectly drained than the remainder of the system. In the recumbent patient, however, the calices are all placed under approximately the same conditions of drainage, and the calculus is frequently found in the upper as well as in the middle and lower calices.

### *Immobilization*

Prolonged immobilization is followed by general decalcification of the skeleton, a fact which is clearly shown by serial roentgenograms and is dramatically demonstrated by the relative frequency of greenstick or crush fractures of the lower limbs when weight-bearing is resumed. In the case of bone or joint disease there is in addition a local decalcification associated with the disease.

Bone is the body's storehouse of calcium, and while this supply is being depleted one would expect the level of the blood calcium to be raised. Mawson determined the serum calcium of six cases of surgical tuberculosis on admission to the hospital, and found the average value to be 9.88 milligrams per 100 cubic centimeters, while the figure for the serum calcium of thirty-four children after a period of recumbency varied between 11.7 and 25 milligrams per 100 cubic centimeters. She attributed this hypercalcaemia to the effects of heliotherapy, but it seems more reasonable to assume that it was a result of skeletal decalcification.

Immobilization has a further influence upon the formation of calculi. It will be seen that in the early stages of formation these calculi are often little more than thin deposits upon the renal walls, and they rapidly disintegrate on movement or change of posture. Rigid fixation effectively preserves these early concretions until consolidation has occurred.

### *Heliotherapy*

Many of the patients requiring prolonged immobilization in recumbency are treated in open-air hospitals, and it has been suggested that increase of vitamin D following irradiation of the skin is responsible for an increased absorption of calcium from the bowel and a high serum calcium. Furthermore it has been claimed that, owing to accelerated skin



TABLE II

ANALYSIS OF FINDINGS IN SIXTY CASES OF NEPHROLITHIASIS OCCURRING IN RECUMBENCY

	No. of Cases	Per Cent
<b>Primary Disease*</b>		
Tuberculosis of spine	26	41.9
Tuberculosis of hip	18	29.0
Tuberculosis of sacro-iliac joint	4	6.4
Chronic infectious arthritis	2	3.2
Perthes' disease of the hip	2	3.2
Septic arthritis of the hip	1	1.6
Anterior poliomyelitis	3	4.9
Fractures	3	4.9
Miscellaneous	3	4.9
<b>Method of Fixation.</b>		
Jones frame	44	67.7
Plaster bed	7	10.8
Thomas splint	3	4.6
Extensions	4	6.2
Plaster casts on legs	2	3.1
Hyperextension jacket	1	1.5
Plaster spica	1	1.5
Skeletal traction	1	1.5
None	2	3.1
<b>Reaction of Urine:</b>		
Acid	35	58.3
Alkaline	2	3.3
Neutral	4	6.7
Unrecorded	19	31.7
<b>Urinary Infection</b>		
Present	21	34.4
Absent	38	62.3
Unrecorded	2	3.3
<b>Site of Stone*</b>		
Both kidneys or ureters	24	38.1
Right kidney or ureter	19	30.1
Left kidney or ureter	13	20.6
Bladder	4	6.4
Unrecorded	3	4.8
<b>Chemical Analysis:</b>		
Calcium phosphate and oxalate	4	6.6
Calcium phosphate ..	1	1.6
Calcium oxalate ..	1	1.6

TABLE II (Continued)

	No. of Cases	Per Cent.
Presenting Sign or Symptom:		
X-ray evidence . . . . .	23	37.7
Symptomless hematuria . . . . .	13	21.3
Renal or ureteric colic . . . . .	11	18.1
Hematuria and colic . . . . .	7	11.5
Simulating appendicular colic . . . . .	2	3.3
Pyelitis . . . . .	3	4.9
Pyuria . . . . .	1	1.6
Abdominal pain and vomiting . . . . .	1	1.6
Sinus:		
Present . . . . .	13	21.7
Absent . . . . .	47	78.3
Results:		
Calculi still present* . . . . .	19	29.7
Natural passage . . . . .	9	14.1
Spontaneous disintegration . . . . .	5	7.8
Calculi disappeared (method uncertain) . . . . .	3	4.7
Nephrolithotomy or ureterolithotomy . . . . .	6	9.4
Nephrectomy . . . . .	3	4.7
Deaths** . . . . .	7	10.9
Unrecorded . . . . .	12	18.7

\* Including four cases known to have hydronephrotic changes.

\*\* Death was due to the following causes: calculous hydronephrosis; renal complication; tuberculous meningitis; amyloid disease and renal failure; renal infection; calculous pyonephrosis; and in one case the cause was unknown.

evaporation, there is a relative increase in the specific gravity of the urine.

It cannot be denied that both hypotheses have a theoretical value, and excessive insolation is to be avoided. However, they do not explain the formation of calculi in recumbent patients who have been treated in closed wards, or the fact that the incidence of stone formation is apparently no higher in summer than in winter.

In an attempt to estimate the importance of skin evaporation, twenty-three patients receiving routine sun treatment were observed over a period of twelve months; the average monthly specific gravity of the urine was found to be constant (1.018) and showed no change between the winter and summer months.

### Urinary Infection

Urinary infection does not appear to be an essential factor in the etiology of calculi due to recumbency, for, in 62 per cent. of the cases in the author's series, the urine was not clinically infected. In some instances it may be the determining factor in the formation, for in several cases a renal shadow appeared following an attack of pyelitis. Infection also has an influence upon the character of the stone, further reference to which will be made later.

### *Extra-Urinary Infection*

Experimental work has shown that focal sepsis may be associated with renal calculi. Paul reported twenty cases of osteomyelitis with renal calculi and concluded that the chronic sepsis and stone formation were related. It appears possible that a persistent bone sinus may have an etiological significance, but it can be only of secondary importance. In the present series chronic bone sinuses were present in only 22 per cent. of the cases, and in a series reported by Key in 50 per cent. It is possible that the calculi in many of Paul's cases were due to the recumbency necessitated by the disease.

### PATHOLOGY

#### *Chemical Analysis*

Analysis has been performed in six cases; in four the stones were reported as being composed of calcium phosphate and oxalate combined; in one, of calcium phosphate; and in the remaining case, of calcium oxalate.

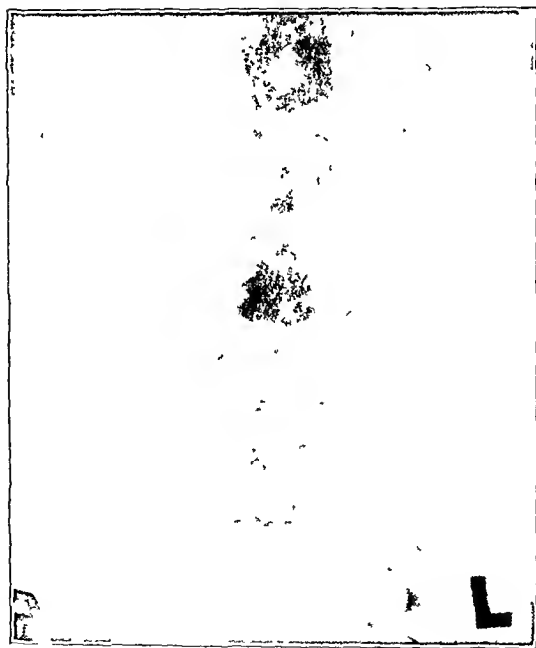


FIG. 1-A

Case 3. E. B., female, aged twenty-one years, with tuberculosis of the lumbar spine and right hip. On admission, March 8, 1933, the renal areas were clear. Following six months of treatment on a frame, routine roentgenographic examination of the spine, on September 26, 1933, showed a large cast in the left kidney and a similar shadow in the right kidney. Eight months later, the patient was allowed to get up, and two weeks later the right kidney was clear and the left kidney was almost clear. Ten months later, April 4, 1935, there were no signs of renal calculi. This case demonstrates the silent nature of the stone and the effect of postural treatment.

Fig. 1-A: March 8, 1933.

These results correspond with the sixteen cases recorded in the literature, in which the stones were composed of phosphate in fourteen and of oxalate in two.

#### *Structure of the Stone*

Two distinct types of stone formation have been observed. The spherical calculus, familiar in urinary surgery, was present in the majority of cases. There are no unusual features about this form. It may be passed without surgical interference if postural treatment is instituted while it is still comparatively small, or it may continue to enlarge until it eventually assumes a stag-horn shape, which occurred in Case 24.

The other type is less common, but of very great interest, and appears to be peculiar to conditions which combine skeletal decalcification with recumbency. A thin film of calcium salt forms

a cast upon the walls of the calici-pelvic system; this development is insidious, and symptoms are usually absent until a change in posture is made. Any such movement may result in the shedding of the deposit into the urinary stream; the fragments pass as gravel down the ureter, and sometimes, but not invariably, cause colic and hematuria. It is interesting to note that spontaneous disintegration has not been seen in any case in the present series once frank urinary infection was present; infection appears to produce a state of fusion which renders dissolution impossible.

Several cases of this renal-cast formation have occurred in the present series; one of remarkable interest was Case 33. Bilateral shadows were discovered after nine months of recumbency. Postural treatment was instituted, and the shadows vanished. Two years later a further treatment in recumbency was necessitated, due to recrudescence of the hip disease. Fourteen months later roentgenograms again detected bilateral renal casts, which disappeared with postural treatment.

#### SYMPTOMATOLOGY

The calculus due to recumbency usually shows itself in either one of two ways,—it may be discovered during routine roentgenographic examination before the development of symptoms, or change of posture may be followed by an attack of colic or hematuria.

In 38 per cent. of the cases in this series, roentgenograms revealed calculi before their presence was suspected. In 54 per cent., hematuria, or colic, or both, drew attention to the kidneys. Hematuria may last for

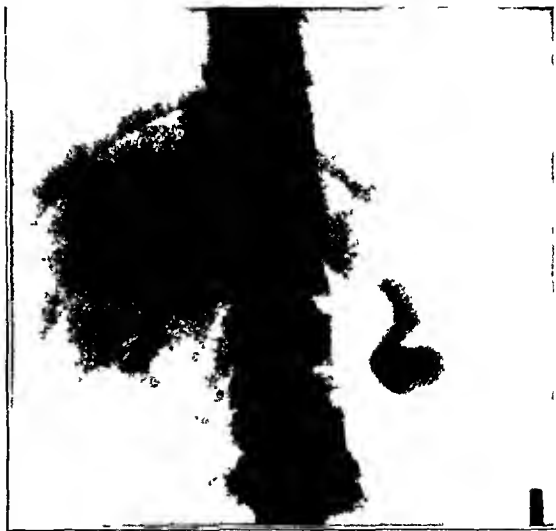


FIG. 1-B  
September 26, 1933.

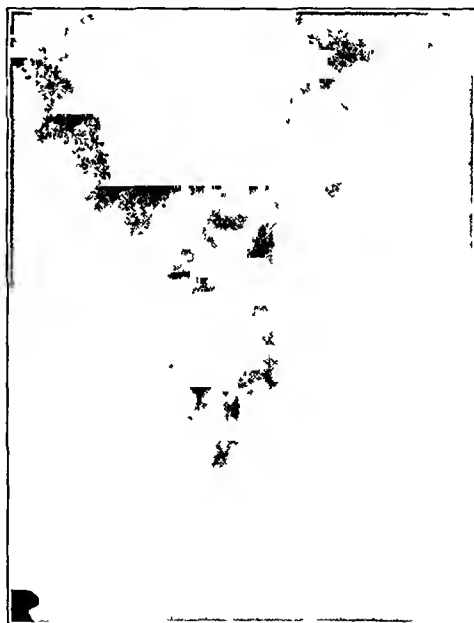


FIG. 1-C  
April 4, 1935.

forty-eight hours, but is often seen in only one specimen. The pain follows a renal or ureteric distribution, but on occasions it has been mistaken for appendicular colic.

Secondary infection may be the sequel of stone formation, and in a small group of cases (7 per cent.) pyelitis or pyuria led to the disclosure of a stone.

#### TREATMENT

##### *Prophylaxis*

There are certain precautions which it is advisable to observe in nursing the patient who must be kept recumbent over a long period:

1. Avoidance of excessive exposure to the sun;
2. Maintenance of a high fluid intake;
3. Regular course of exercises for those parts of the body which do not require immobilization.

Unfortunately these measures are only supplementary and do not abolish the main potential

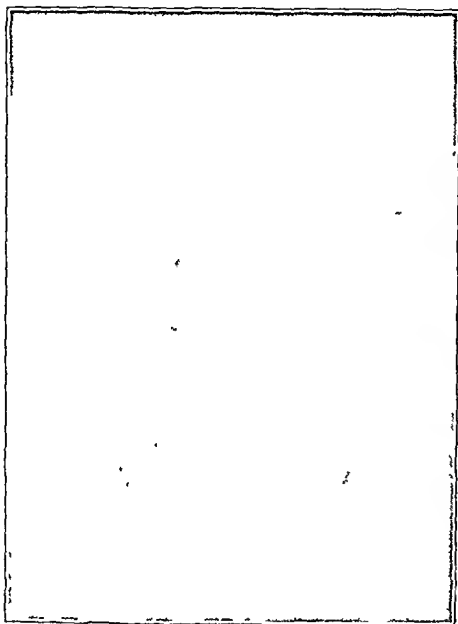


FIG. 2-A



FIG. 2-B

Case 24. H. W., female, seven years old, with Pott's disease of the lumbar spine. On admission on July 9, 1930, the renal areas were clear. After six months of treatment on a frame, the patient had an attack of pyelitis. This was disregarded and after one year's treatment she was allowed up with a spinal support. Roentgenograms six months later showed a left renal stone, which gradually increased in size. Nephrectomy was performed five years after original admission. This case demonstrates the consolidation produced by infection.

Fig. 2-A: Intravenous pyelogram, September 21, 1935.

Fig. 2-B: Stone removed at nephrectomy, April 23, 1936.

cause of stone formation. Some means must be devised to overcome the defective drainage of the kidneys.

A very simple method is bed tilting. The head and foot of the bed are raised alternately on blocks. This induces drainage from the upper and lower calices, but does not alter materially the main watershed of the kidney.

Pugh, of Carshalton, has devised a special frame which incorporates the movements of lateral tilting with uninterrupted fixation. This ingenious frame is used at the Queen Mary's Hospital, Carshalton, and has given good results. This frame is elaborate, however, and the method now to be described is simpler and equally efficacious.

This method consists of turning the patient at regular intervals from the supine to the prone position into a plaster shell. The technique is simple, and the principle is sound. Its efficiency is demonstrated by the frequency with which turning after prolonged recumbency has been followed by colic and hematuria. The method has been used for over two years in one ward at the Liverpool Open Air Hospital for Children, Leasowe, and since its institution no new cases of renal calculi have appeared. An anterior plaster shell is molded for each patient, who may already be lying on a frame or plaster bed. This shell is strapped on firmly, and the complete ensemble is turned by a team of four nurses in the manner used for turning a racing eight. The straps are unbuckled, and the frame is removed from the shell. A trained

staff can accomplish this in less than two minutes. The patient is allowed to lie in the shell for several hours, and care is taken that the immobilization of the diseased part—whether it be the spine, the sacro-iliac joint, or the hip joint—is maintained both during the manoeuvre and subsequently. This turning procedure soon becomes part of the ward routine, and even in a large ward need not become unduly exacting upon the staff, as each patient will require to be turned only once a fortnight. A criticism has been made that the extra movement is injurious to the diseased area. The author has not yet seen evidence to support this, and, apart from a few exceptional cases, injury can be avoided by the use of a well-molded shell and careful technique. In many orthopaedic hospitals the nursing staff are already familiar with this method of turning for the purpose of examination and treatment of the back.

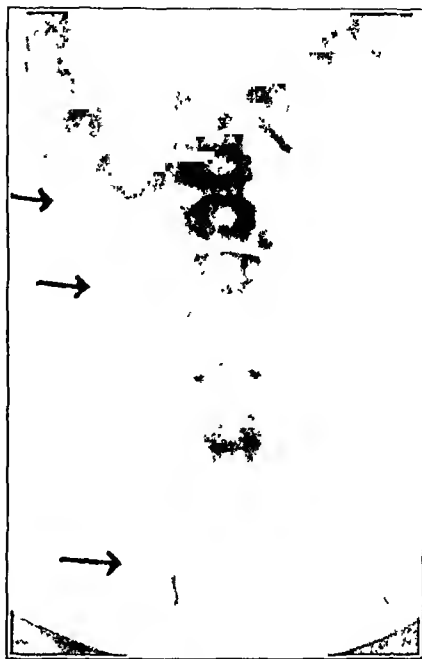


FIG. 3

Case 37. I. MacL., male, nine years of age, with tuberculosis of the left hip. No roentgenograms of renal area were taken on admission. Following four months of treatment on a frame, he had an attack of severe abdominal colic, for which an emergency appendectomy was performed. The appendix was found to be normal, and a calculus was palpated in the lower end of the right ureter. The postoperative roentgenogram showed a collection of stones in the right kidney and one stone in the right ureter, which was passed naturally seven days later. This case demonstrates the possibility of a mistaken diagnosis.

### *Treatment of the Established Condition*

The early diagnosis of a stone is important, and routine roentgenographic examinations of the renal areas should be made. In the early stages calcium deposits throw a poor shadow, which may be obscured by meteorism, and it is essential to ensure an adequate bowel clearance before roentgenograms are taken.

Where no precautionary measures have been adopted and calculous deposits have developed, routine turning or ambulatory treatment should be instituted without delay, and experience shows that the cast type of deposit will in most cases disintegrate, provided no infection is present. The spherical calculus provides a more difficult problem, for, unless it can be persuaded to pass down the ureter intact, surgical intervention may be necessary. Postural or ambulatory treatment is indicated as a first measure, and it is surprising to see the large stone that is sometimes passed without any other assistance. When a stone refuses to pass, a major surgical problem arises, because of the general condition of the patient, the difficulty of movement, and, in the case of spinal disease, rigid deformity which adds to the difficulties of renal exposure.

### PROGNOSIS

There is a tendency to regard the calculus of recumbency as a minor complication. This impression has probably arisen from the fact that

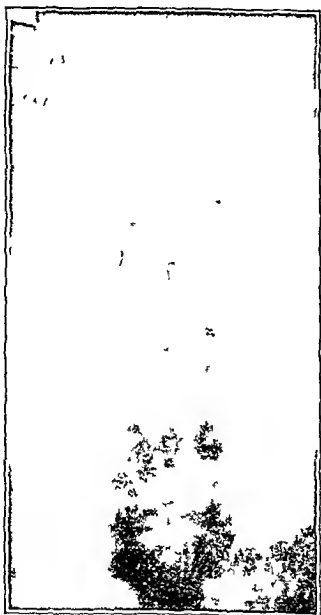


FIG. 4-A



FIG. 4-B

Case 58. M. B., female, aged twenty-eight, with chronic osteomyelitis of the ilium. On admission, March 14, 1936, the renal areas were clear. Following recumbency for fixation for four months and a plaster bed for one month, roentgenograms on August 12, 1936, showed gross calculus formation in the left kidney. The patient died one month later, and autopsy revealed pyonephrosis with multiple soft calculi.

Fig 4-A: March 14, 1936.

Fig. 4-B: August 12, 1936

many of the calculi disappear when the patients become ambulatory, and one is led to believe that all cases will follow this favorable course.

Unfortunately a study of the final results shows that the reverse is more often true. In the present series of sixty unselected cases, the calculi vanished in 27 per cent. without recourse to surgery; they were still present in 30 per cent. at the time when this report was written, the observation period ranging between five months and seven years after the resumption of activity in those cases in which it was possible to obtain complete records. In 9 per cent. the calculi were surgically removed from the kidney or ureter. Five per cent. (three cases) came to nephrectomy. There were seven deaths (11 per cent.); the renal condition was directly responsible for three and probably was an accessory factor in three.

### CONCLUSIONS

1. Prolonged immobilization in recumbency may lead to the formation of renal calculi.
2. This is chiefly due to the combination of defective renal drainage and skeletal decalcification.
3. The composition of the calculi is usually calcium phosphate.
4. Hematuria and abdominal pain may follow alteration in posture and may lead to the discovery of the stone, although in some cases the stone may be unsuspected until revealed by the roentgenogram.
5. Patients who need to be recumbent for long periods should undergo postural treatment and have routine roentgenographic examination of the renal tracts.
6. Many of these calculi occurring in recumbency disappear when the erect posture is resumed, but a large proportion remain and may require surgical removal.
7. The complication may be fatal.

The author wishes to express his gratitude to the honorary and resident staffs of the following hospitals from which the cases have been obtained: The Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry; Biddulph Grange Orthopaedic Hospital; Liverpool Open Air Hospital for Children, Leasowe; North Wales Sanatorium, Denbigh; Prince of Wales Orthopaedic Hospital, Cardiff; Royal National Orthopaedic Hospital (County Branch), Stanmore; Royal Salop Infirmary, Shrewsbury; St. Vincent's Orthopaedic Hospital, Eastcote.

Special thanks are due to Miss Burnand for the prints from the roentgenograms; and to Mr. B. T. Keon-Cohen for many helpful suggestions.

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## AFFECTIONS OF MUSCLES

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The present study of muscle affections comprises two distinct pathological groups,—one neoplastic and the other inflammatory or myositis.

Myositis is a comparatively common condition. It is a frequent sequel of injuries, mechanical irritation, muscle paralysis, and vascular disturbances. Pyogenic bacteria and toxins are common etiological factors. Syphilis, non-contiguous tuberculosis, and exanthematic diseases occasionally are responsible for muscle inflammation. Depending on the variety, the myositis may be acute or chronic, solitary or multiple, and it occasionally occurs in epidemic form (Richter and Levine, Massell and Solomon, and Morgan).

In a total of 153 cases of muscle affections involving the extremities, body wall, and neck, recorded in the Surgical Pathological Laboratory, there were 108 cases of inflammation. Cases of chronic myositis made up the bulk of this inflammatory group. There were fifteen cases of tuberculosis, eight of syphilis, six of trichinosis, and nineteen of chronic non-specific myositis. There was one instance of post-diphtheritic myositis, and two of chronic inflammation associated with progressive muscular atrophy. Twenty-five cases of myositis ossificans had been reported in a recent communication. The remaining cases of the chronic inflammatory group were associated with torticollis and Volkmann's ischaemia. There were eight additional cases of acute inflammation. (See Table I.)

The incidence of primary tuberculosis of muscle is relatively low (Hanke), while the occurrence of the lesion without a primary focus is questionable (von Meyenburg). The present series includes cases of primary tuberculosis of muscle without evidence of a focus elsewhere. Since the studies were limited to pathological analysis of the lesions and clinical observation of the patients, it was not possible to determine specifically whether a quiescent lesion actually existed. The age at onset varied from eleven to sixty-eight years, and three times as many males were affected as females. The symptoms usually consisted of pain and tenderness, while a firm indurated mass was noted in several instances. In one case there was a chronic suppurating ulcer. The lesions were solitary and the locations, in order of frequency, were the thigh, neck, scapula, forearm, arm, and abdomen. The gross and microscopic findings were identical with those of tuberculosis elsewhere.

In the eight instances of syphilis there were two types of inflammation,—one diffuse and the other gummatous. The age varied from

TABLE I  
TABULATION OF MUSCLE AFFECTIONS

Affection	No. of Cases
Myositis:	
Acute:	
Non-specific—abscess formation.	6
Non-specific—no abscess formation	2
Chronic:	
Non-specific—abscess formation.	2
Non-specific—no abscess formation	17
Tuberculosis.	15
Syphilis. . . . .	8
Trichinosis	6
Torticollis	17
Volkmann's ischaemia	7
Myositis ossificans	25*
Diphtheria	1
Progressive muscular dystrophy	2
Muscle Tumors—Primary:	
Benign myoblastoma of the extremities and body wall . . . . .	6
Rhabdomyoma.	
Differentiated.	0
Undifferentiated	0
Leiomyoma. . . . .	1
Rhabdomyosarcoma	
Differentiated . . . . .	0
Undifferentiated	13
Leiomyosarcoma	1
Muscle Tumors—Secondary:	
Fibroma	10
Fibromyxoma	1
Angioma	5
Lipoma	1
Liposarcoma	4
Angiosarcoma	1
Neurogenic sarcoma	2

\* Geschickter and Maseritz See References

twenty-three to sixty years, averaging forty-four years. Males were affected more often than females in a ratio of two to one. In six instances the lesions proved to be diffuse and presented symptoms similar to those of tuberculosis except that no ulcers were observed. The deltoid, pectoral, quadriceps, and flexor muscles of the forearm were involved once each; the sternocleidomastoid, twice. The pathological findings in this diffuse group were those of chronic inflammation. These findings consisted of fibrosis and lymphocytic invasion. The diagnosis of syphilis was based on a positive blood Wassermann and rapid response to antiluetic treatment. The two gummatous lesions of the pectoral and

flexor muscles of the forearm were firm and indurated masses, which were quite similar to sarcomatous growths. Pathologically the findings were those of gumma. The lesions responded to antiluetic treatment.

There were nineteen cases of chronic non-specific myositis in this series. The underlying etiological factors were pyogenic bacteria and toxins. There were two males to one female, and all of the patients were of the white race. The ages varied from one to forty-eight years. Trauma played no rôle except for one possible instance where the injury was of two years' duration. Abscesses were present in two of the cases. Multiple lesions of myositis occurred only once, and in this instance abscesses were found in both thighs. The locations of the muscles involved were variable, the extremities being most commonly affected. The pathological findings were like those of inflammation elsewhere, and the muscles were commonly replaced by new fibrous tissue.

Trichinosis is responsible for a specific variety of chronic myositis and is caused by the worm, *trichinella spiralis*, which is found encysted in the muscles. Infection of the human is usually caused by ingesting improperly treated ham or pork. The worms gain entrance to the intestinal tract as larvae and mature within three days after ingestion. Copulation takes place very early, and the young are deposited in the blood or lymph vessels by the female, which burrows through the mucosa of the small intestines. The larvae have an affinity for skeletal muscles in which they become encysted and remain alive as long as twenty-five or more years. The larvae measure from twenty-five hundredths to five-tenths of a millimeter and can be observed with the naked eye in muscle infected with the disease.

The earliest symptoms are the result of ingestion and consist of nausea, vomiting, abdominal pain, and diarrhoea. Gastro-intestinal symptoms are observed within forty-eight hours after the patient has partaken of infected food. Swelling of the eyelids, face, and hands is commonly observed about the tenth day. Muscle pain and clinical symptoms of acute myositis manifest themselves when the worms invade the muscle fibers. Eosinophilia is a frequent finding in trichinosis, but has also been reported in other forms of myositis (McAlpine, Krohn).

The mortality rate and extent of symptoms are dependent upon the number of worms ingested. The mortality rate may reach 30 per cent. (Chandler), and, when only a few worms are ingested, the etiological factor of the ensuing myositis may be overlooked. "Rheumatic myalgia" is a common finding.

In the present series under consideration, typical symptoms of trichinosis were encountered in one instance; in the remaining cases a diagnosis was made only after biopsy of the muscles. In two cases the clinical findings were suggestive of arthritis, and in one of these fluid was found within the joint.

Age appears to play no important rôle. The youngest patient was a child, who was admitted to the Harriet Lane Hospital when she was two

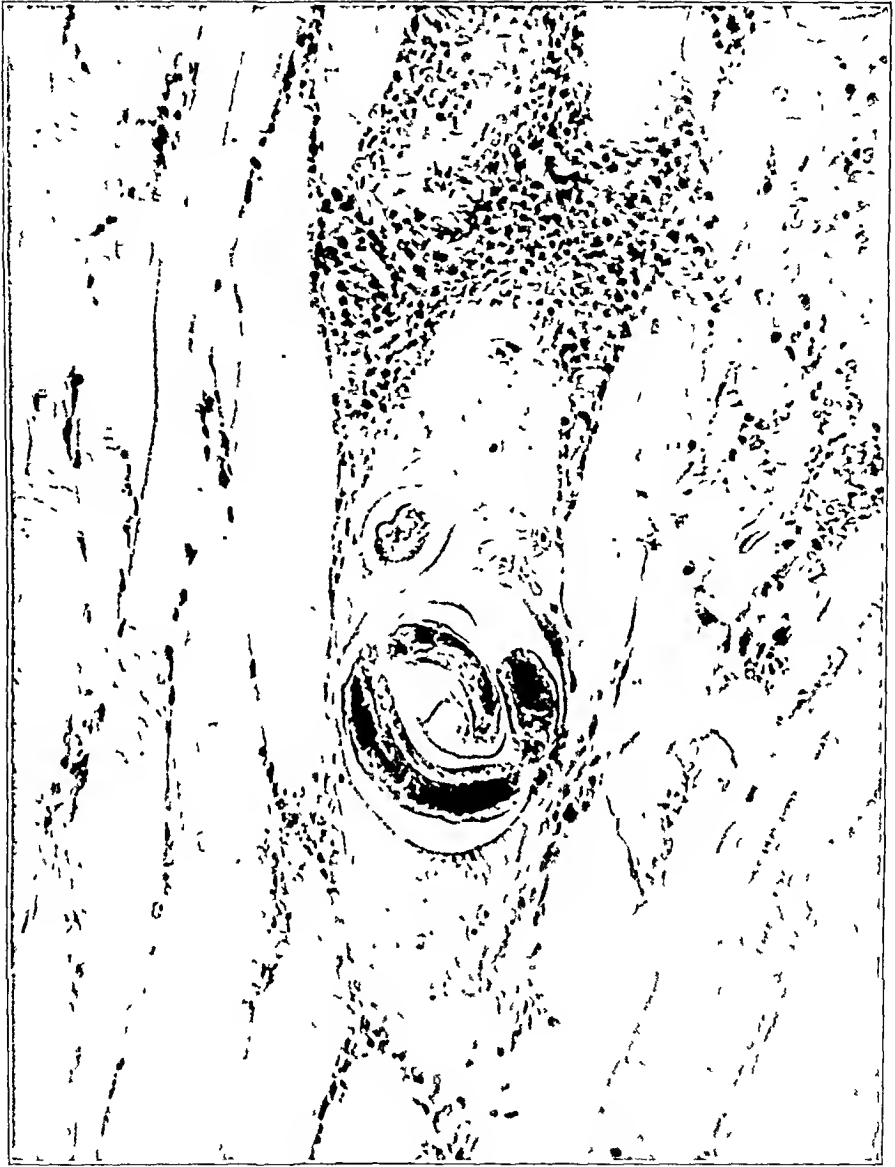


FIG. 1

P. N 33058 Photomicrograph (low magnification) of encysted larvae in the striated fibers of voluntary muscle.

years old. Her present illness had begun at twenty months of age, when her mother had noticed that she was quite fretful, seemed "feverish", and cried when handled. The child did not appear to be ill, but was quite apprehensive. The ankles were swollen, and the child was unable to walk. Oedema of the eyelids and hands, feet, shins, and sacrum was present. There was a profuse generalized perspiration, and the extremities were cold. The biceps, triceps, patellar, and tendo-achillis reflexes were absent. There was no disturbance of sensation other than the

generalized hyperaesthesia. The blood pressure was 95/60, while the temperature ranged from 97 to 98 degrees Fahrenheit. The pulse varied from 100 to 130 per minute. The laboratory findings were unimportant except for a slight increase in eosinophiles of the blood cells. A biopsy of the gastrocnemius muscle demonstrated the presence of trichinae.

In each instance in the present series, the diagnosis of trichinosis was dependent upon biopsy of the muscle and required careful analysis, for sections would often fail to show the nematodes or capsules. The earliest changes observed in the muscle fibers were a loss of the cross striations, swelling, and an accumulation of large cells resembling those ordinarily seen in the sarcolemma. Larvae of various sizes were found to occur either singly or in groups and were observed in the muscles occupying the breadth of one or more fibers (Fig. 1). In some instances they were surrounded by collections of lymphoid cells and leukocytes; in others, by cysts, which were granular or hyaline-like in character and were occasionally calcified. The general picture was that of a chronic inflammation, and fibrous tissue commonly replaced the normal muscle structure.

There were seven instances of Volkmann's contracture, and the material available for study was sectioned from muscles in the late stage of this affection. Bristow, in a study of the various stages of Volkmann's ischaemia, described the earliest changes somewhat as follows: The muscle fibers, sarcolemma, fibrous tissue, and blood vessels lose their nuclei. The interstitial fibrous tissue proliferates, and the muscle bundles become shrunken, while the individual fibers show a coarseness of the cross striations. Round-cell infiltration is observed beneath the sarcolemma, between the first several layers of fibers, and at the attachment of the muscle to the tendon. The last stage is one of fibrosis, the muscle fibers being replaced by connective tissue. The pathological study of the cases in this series showed muscle atrophy and destruction. Fibrous tissue with round-cell infiltration replaced normal muscle.

Chronic myositis in torticollis shows fibrosis in the gross specimen, and microscopically the changes are those of non-specific chronic inflammation.

The case of post-diphtheritic myositis presented changes of chronic inflammation, while the instances of progressive muscular atrophy showed, in addition to displacement of muscle fibers by fat, a picture of fibrosis and chronic inflammation.

There were eight cases of acute inflammation. The muscles involved were the psoas, popliteus, sacrospinalis, iliacus, and rectus femoris. The cause of one case was trauma; the acute myositis in another was secondary to an infected toe; while no ascertainable causes could be found for the remaining cases. The clinical symptoms were those of acute inflammation, and abscesses were present in six. Grossly and microscopically the changes were similar to those of acute inflamma-



FIG. 2

P. N. 46281. Photomicrograph (low magnification) of a leiomyoma arising in the smooth muscle. The transverse bundles of muscle, to the left, are normal tissue. The tumor tissue to the right of these bundles does not assume the histological characteristics of normal smooth muscle fibers.

tion elsewhere, and were coupled with a general tendency to fibrosis.

In brief, diagnostic difficulties more often arise in cases of chronic myositis than in the acute form. In acute myositis, clinical features of acute inflammation usually make the diagnosis a relatively easy matter. In chronic myositis, unless there is a characteristic clinical picture such as Volkmann's contracture, the clinical examination should aim at ruling out tuberculosis, syphilis, trichinosis, or the exanthematic diseases. In obscure cases biopsy should be performed.



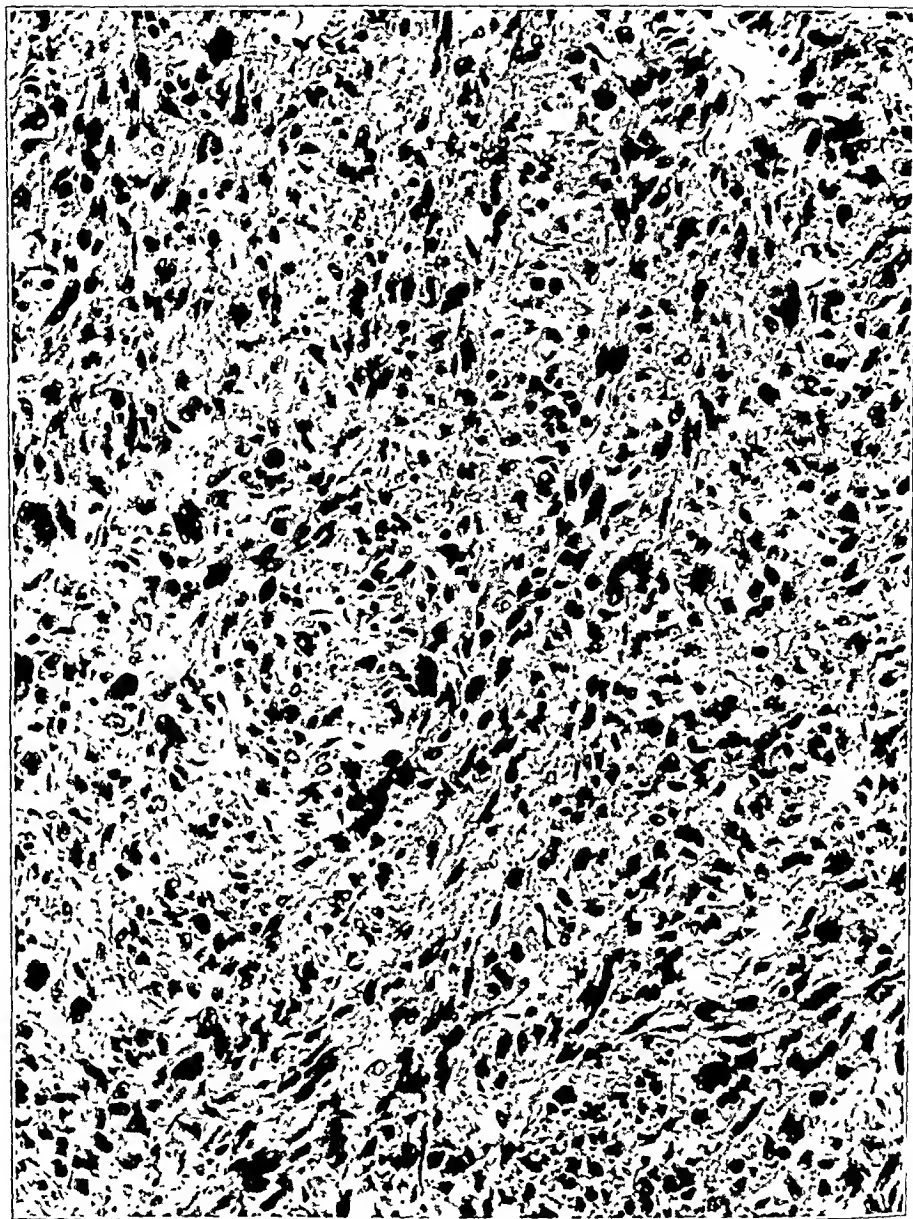


FIG. 3

P. N. 44516. Photomicrograph (low magnification) of typical histological changes in a leiomyosarcoma.

#### NEOPLASMS OF MUSCLE

There were forty-five instances of muscle tumors in the present series. All of these tumors involved the musculature of the trunk or of the extremities. These growths arose either primarily from primitive muscle tissue or secondarily from such structures as nerves, blood vessels, fat, or connective tissue.

Primary muscle tumors are related to primitive muscle tissue, since the adult fibers are incapable of reproduction. All muscle cells have their



FIG. 4

P. N. 57886 Photomicrograph (low magnification) of a benign myoblastoma

origin in mesenchyme, and the individual cells are formed through an intermediate stage in which the spongioplasm of the syncytial cells is drawn out into longitudinal processes (Carey). A myoblastic stage, in which the protoplasmic process becomes striated, precedes the formation of voluntary muscle. The distinction between voluntary and involuntary muscle is dependent on tension exerted upon the embryonic cells, according to Carey, who believes that the greater tension results in the formation of striated muscle

Tumors of muscle attempt to repeat the histogenesis of the structure involved and are recognized microscopically by the forms assumed. The more primitive parent tissue is mesenchyme and is characterized by a fibrous or fibromyxomatous appearance. The tissue is



FIG. 5

P. N. 57346. Photomicrograph (high magnification) of a malignant myoblastoma (rhabdomyosarcoma).

identical histologically with benign or malignant embryonal fibroblastomata and often cannot be differentiated from them. In our experience the standard stains for muscle fibers—such as Mallory's, van Gieson's, and Masson's trichrome stain—have little or no value in distinguishing the embryonic forms, and these early types of myogenic tumors may be mistaken for undifferentiated fibrosarcomata or malignant nerve-sheath tumors.

In the formation of tumors of smooth muscle the mesenchyme gives rise to elongated, wavy muscle fibers, which do not necessarily assume the histological structural characteristics of normal tissue (Fig. 2), and

malignancy is characterized by the presence of many bizarre forms of multinucleated cells (Fig. 3).

The embryonic cells of voluntary-muscle tumors produce myoblasts.

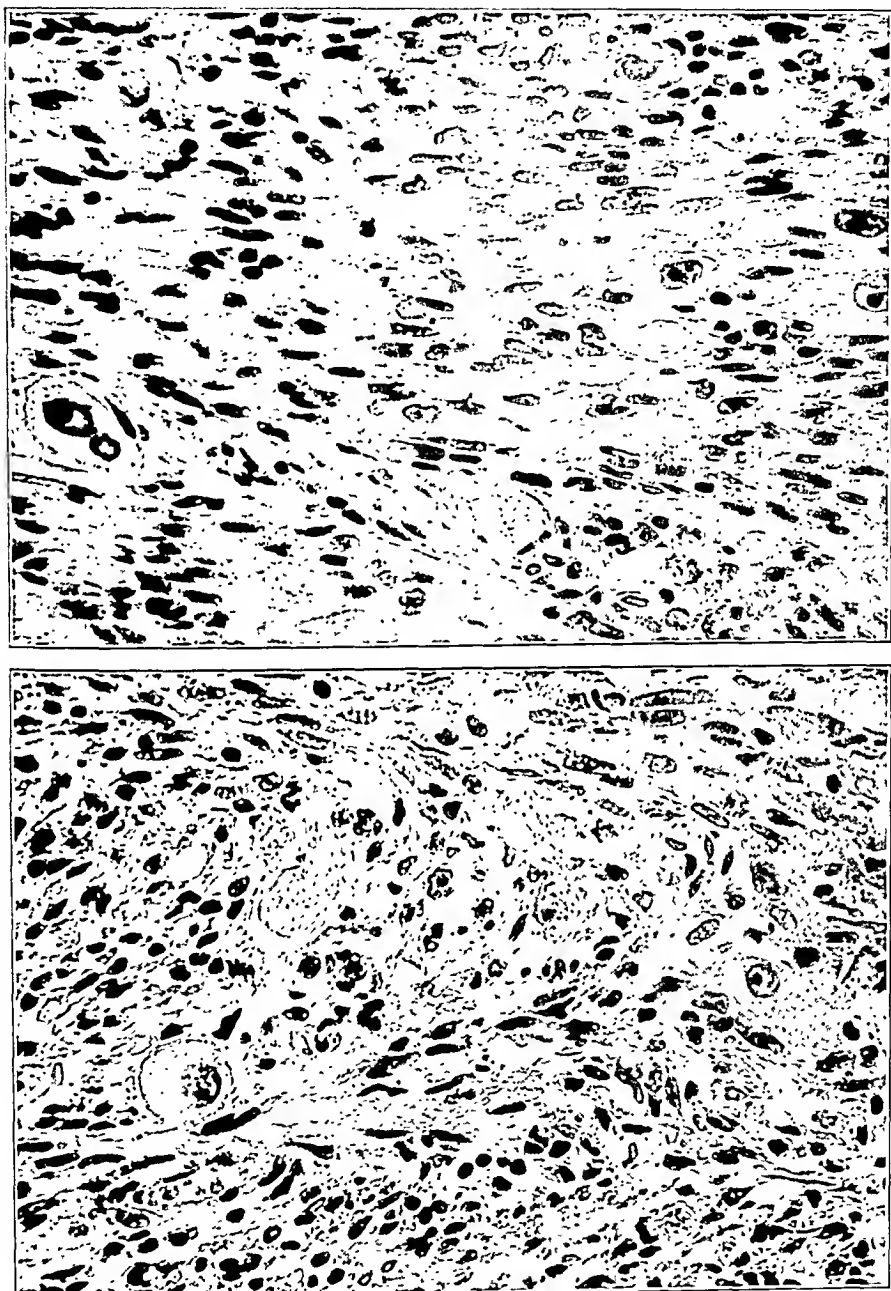


FIG. 6

P. N. 59318. Photomicrograph (high magnification) of a rhabdomyosarcoma, showing elongated myoblasts with blunt ends. These cells make up the bulk of the tissue in the upper section of the photomicrograph. Note the giant cells, one being multinucleated (plasmodium type). The tissue of the lower section is, for the most part, mesenchyme.

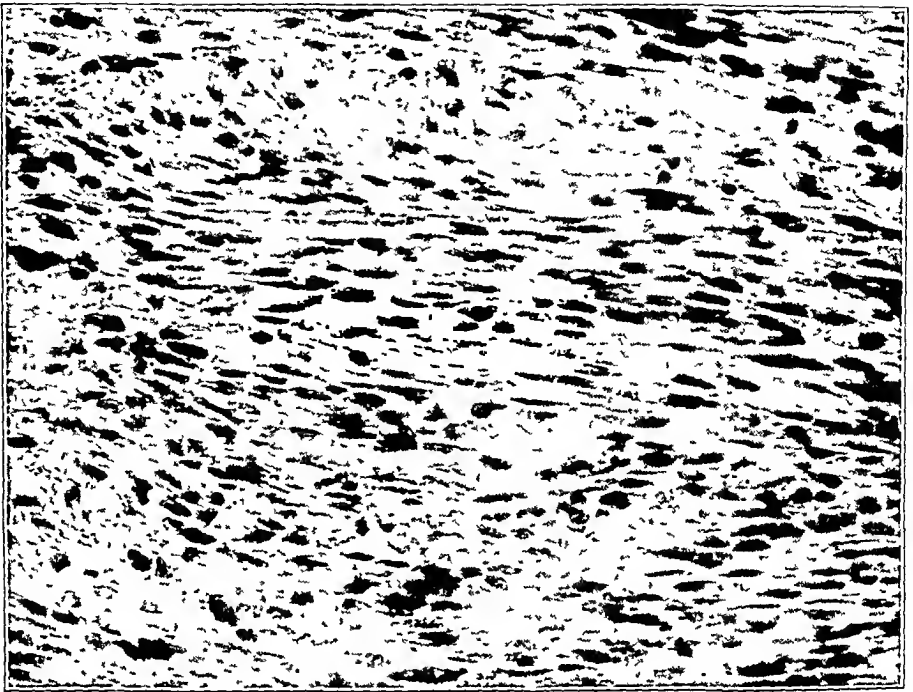


FIG 7

P. N 59318 Photomicrograph (medium magnification) of a rhabdomyosarcoma in which the fibers resemble those of smooth muscle.

These myoblasts may be very similar in appearance to the foam cell of the reticulo-endothelial system (Figs. 4 and 5). In both the benign and malignant types of voluntary-muscle tumors the myoblasts may form elongated protoplasmic processes, which can become striated. These cells, when not striated, are often differentiated from neighboring mesenchymal cells by their broad, blunt, irregular ends (Fig. 6). In some instances they assume the form and appearance of large, smooth muscle cells, and then they are distinguished with difficulty (Fig. 7)

Giant cells were commonly encountered. They were small or large, oval or round, and contained one or more nuclei (Fig. 6). The significance of these cells is questionable. They may be regarded as malignant manifestations of tumor origin, or, according to some observers, they are the product of degeneration in preexisting adult muscle fibers. Certain distinctive differences have been observed by Rakov, who divided these giant cells into three groups. The most significant variety, a plasmodium type, was described as being large, granular, and containing a vacuolated cytoplasm and many nuclei. He considered its presence an important adjunct in forming a diagnosis of rhabdomyosarcoma. We agree with Rakov, but wish to emphasize the fact that similar cells may also be observed in other tumors, especially in sarcoma of lipomatous tissue.

In the files of the Johns Hopkins Hospital there are recorded over 6000 involuntary-muscle tumors, the so-called leiomyomata. All but thirty-eight originated in the uterus; the remaining, with one exception,



FIG. 8

P. N. 52766. Photomicrograph (medium magnification) of a leiomyoma arising from smooth muscle tissue of blood vessels

were distributed in the genito-urinary and gastro-intestinal tracts. There were sixty-four instances of malignant tumor of smooth muscle designated as leiomyosarcoma. There were two instances in which these tumors arose in the extremities. In one case a tumor, apparently composed of smooth muscle fibers, invaded the voluntary muscles of the thigh. The patient, a white male, complained of a mass above the right knee of two years' duration. Examination showed a tumor about three centimeters in diameter and firm in texture. Grossly, it was found to be an encapsulated growth, myxomatous in nature. Microscopically, the tissue was fibromyxomatous. Large non-striated fibers, proliferating around blood vessels, were distributed throughout the section (Fig. 8). Since



FIG 9

P. N. 47758. Photomicrograph (medium magnification) of a leiomyosarcoma arising in the voluntary muscles of an arm.

the arrectores pilorum and the cutaneous arterioles have been described as sources for leiomyomata by Hess, Ormsby, and others, it is possible that this tumor arose from the smooth muscles of blood vessels and accordingly was designated as a leiomyoma. Some observers believed this tumor to be an undifferentiated rhabdomyoma. In a second case, a white male, thirty-six years of age, had noticed a gradually growing mass in the arm. The tumor, situated beneath the deltoid muscle, was removed and roentgen-ray therapy was instituted. The growth recurred in two



FIG. 10

A gross specimen of benign myoblastoma (Courtesy of the American Journal of Cancer.)

years, necessitating a shoulder-girdle amputation. The microscopic examination showed voluntary-muscle bundles being replaced by a very vascular tissue. The capillaries were surrounded by whirling bands of fibers and in areas resembled the leiomyoma previously described (Fig. 9). The tissue, however, contained many malignant cells with large nuclei and long fibrils and many multinucleated forms. It is our belief that this tumor arose in the musculature of the blood vessels.

TABLE II

CASES OF MYOBLASTOMA COLLECTED FROM THE SURGICAL PATHOLOGICAL LABORATORY

Site	No. of Cases
Muscles of arm	1
Muscles of forearm	1
Muscles of thigh...	1
Muscles of chest wall	1
Subcutaneous region of the sacrum	2

There were nineteen instances in which striated muscle tumors arose in the body wall or extremities. These tumors were of two types, benign and malignant. The most common benign type was first discovered by Abrikossoff in 1926, who named it myoblastoma. Klinge, Gray and Gruenfeld, von Meyenburg, Klemperer, and others have since added other cases to the literature. The tumor represents an intermediate stage between myogenic syncytium and fully developed striated muscle fibers. The most common locations reported for such myoblastomata are the tongue and oral cavity. The present series includes six cases of myoblastoma,—two in the subcutaneous region of the sacrum, and one each in the muscles of the forearm, arm, chest, and thigh. These are firm en-





FIG. 11

P. N. 56334. Photomicrograph (low magnification) of a rhabdomyosarcoma in which the tissue closely resembles fibrosarcoma. Note the collection of myoblasts in the left portion of the section.

encapsulated benign growths (Fig. 10), which ordinarily occur in the second and third decades of life. The histological changes are at times similar to those observed in xanthomata, but the cells are more granular than foamy, and are separated by broad myogenic fibers rather than by thin strands of connective tissue (Fig. 4).

There were thirteen cases of undifferentiated rhabdomyosarcoma. Clinically these tumors are single or multiple and assume various forms. The consistency is soft and doughy, and they are gray in appearance. They are diffuse or circumscribed and may be encapsulated. Two dis-

inct histological types of tissue were recognized in these undifferentiated tumors,—mesenchyme predominated in one and myoblastic elements in the other. One case was that of a white male, thirty-five years of age, who had noticed a mass in the right thigh of three years' duration. In the four months prior to examination the growth had become rapid. Mediastinal pain developed, which later proved to be the result of metastasis. Microscopic studies of the sections showed spindle cells and round cells of the myoblastic type, and mesenchymatous tissue. There were areas of longitudinal bands of cross-striated muscle, which were invaded by cells with hyperchromatic and multiple nuclei, many bizarre forms, and plasmodium cells (Figs. 6 and 7). Histologically the changes closely resembled those of a neurogenic sarcoma. This similarity between neurogenic sarcoma and rhabdomyosarcoma was even more marked in a less differentiated type of tumor which involved the muscles of the back. The tissue was suggestive of a fibrosarcoma in which fibromyxomatous tissue and myoblasts were interspersing elements (Fig. 11).

In several instances malignant myoblasts formed the bulk of the tumor. This is best illustrated in a case of a white female, who had the distal phalanx of a finger curetted for a cyst. She experienced repeated fractures, and the finger was finally amputated six years later. The microscopic section presented bizarre forms of myoblasts invading and destroying bone (Fig. 5). The remaining cases of this group, tabulated in Table III, presented pathological changes similar to those already described, and histologically formed a variable but consistent picture, which could be designated as mesenchymatous, myoblastic, or mesenchymomyoblastic.

The benign non-indigenous tumors invading muscle were as follows: five angiomas, ten fibromas, one lipoma, and one fibromyoxoma. These were comparable to similar tumors elsewhere. There were four cases of liposarcoma, one case of angiosarcoma, and two cases of neurogenic sarcoma. With the exception of the angiosarcoma, these malignant tumors offered a difficult problem in diagnosis. Embryonic forms of all muscle tumors will show fine fibrils and spindle cells, thus simulating the sarcoma of the nerve sheath which invades muscles. Liposarcoma may resemble undifferentiated forms of muscle sarcoma and cannot always be differentiated by special staining.

The treatment in each of the five instances of primary benign muscle tumors was conservative and consisted in simple excision. The minimum time elapsing since operation was fourteen months, and the maximum was four years. There were no recurrences. The series of primary malignant tumors totalled fourteen. There was only one instance in which an amputation was performed primarily, the remaining operable cases having been originally treated by excision. This case has not been followed. We were able to trace eleven of the remaining cases and found that the growths had recurred in all but one. In three of these recurrent cases the patients died of metastases; in another, the patient

TABLE III  
PRIMARY MUSCLE TUMORS \*

Pathol. No.	Race	Sex	Age at Onset (Years)	Location of Growth	Injury	Duration of Symptoms	Treatment	Diagnosis	Result
5931S	White	Male	35	Thigh	No	3 years	Biopsy Inoperable	Undifferentiated rhabdomyosarcoma	Patient died of metastasis.
5909S	White	Female	52	Thigh	Yes		Excision	Undifferentiated rhabdomyosarcoma	Tumor recurred. Patient still living. Tumor inoperable.
5788G	Colored	Female	62	Arm	No		Excision	Myoblastoma	Patient well 14 months after operation.
57880	Colored	Female	45	Pectoral muscle	No	1 year	Excision	Myoblastoma	Patient well 14 months after operation.
5734G	White	Female	21	Distal phalanx	No	6 years	Phalanx everted for cyst. Finger amputated 6 years later.	Undifferentiated rhabdomyosarcoma	Patient well 1 1/4 years after last operation.
57004			Newborn infant	Beneath biceps	No		Excision	Undifferentiated rhabdomyosarcoma	Patient well 2 years after operation.
56334				Muscles of back	No		Excision	Undifferentiated rhabdomyosarcoma	Patient died of metastasis 9 months after operation. Recurrence.
56084				Thigh	No		Excision	Undifferentiated rhabdomyosarcoma	Recurrence. Patient not traced further.
5394G	White	Female	46	Pectoral muscle	No	Several months	Excision	Undifferentiated rhabdomyosarcoma	Patient died of metastasis 11 months after operation. Recurrence.
53901	White	Female	40	Neck muscles	No	2 years	Excision	Undifferentiated rhabdomyosarcoma	Patient died of extensive metastasis 1 year after operation. Recurrence.

TABLE III (Continued)

Pathol. No.	Race	Sex	Age at Onset (Years)	Location of Growth	Injury	Duration of Symptoms	Treatment	Diagnosis	Result
53398	White	Male	Adult	Forearm	No	Several months	Excision	Myoblastoma	Patient well 4 years after operation.
52766	White	Male	43	Thigh	No	2 years	Excision	Leiomyoma	Patient cured.
49928	White	Male	Adult	Thigh	No		Excision	Myoblastoma	Patient well.
49366	White	Female		Shoulder	No		Excision. Amputation of shoulder girdle following recurrence.	Undifferentiated rhabdomyosarcoma	Patient not traced.
49329	White	Female	49	Arm	No	6 months	Disarticulation of shoulder	Undifferentiated rhabdomyosarcoma	Patient not traced.
47758	White	Male	36	Deltoid	No	6 months	Excision	Leiomyosarcoma	Recurrence after 2 years. Patient not traced further.
46768	White	Male	52	Clavicle	No	7 years	Excision	Undifferentiated rhabdomyosarcoma	Patient not traced.
45247	Colored	Female	59	Thigh	No		Excision	Undifferentiated rhabdomyosarcoma	Recurrence. Patient refused operation. Not traced further.
41008	White	Male	68	Mid-thigh	No	35 years	Excision	Undifferentiated rhabdomyosarcoma	Patient had 2 recurrences. Died of cerebral thrombosis 2 years after operation.

\* Two cases of myoblastoma have been omitted from this table because of incomplete data.

died of cerebral thrombosis following an operation for excision of the tumor. Three patients of the malignant group are still living: two are well, and the third has an inoperable tumor. Three cases were incompletely traced.

An attempt was made to evaluate the degree of malignancy in sarcoma of muscle by histological study. No correlation between the microscopic variety and the clinical course was evident. We believe that amputation in primary malignant tumors of muscle is the operation of choice.

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# PRINCIPLES INVOLVED IN THE TREATMENT OF CONGENITAL CLUB-FOOT \*

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The purpose of this paper is to make a plea for conservative treatment of congenital club-foot and to call attention to certain mechanical and pathological principles involved. It is the author's experience that most club feet can be successfully corrected by a series of plaster casts and wedgeings, without the use of anaesthetics, forcible manipulations, or operative procedures, and with far better results.

Before the era of modern surgery, numerous machines were devised for the forcible correction of club feet, and a variety of braces were worn. With the advent of aseptic surgery there were described in rapid succession a large number of operations, first on the fascia and tendons, and a little later on the bones and joints of the foot. It seems that the chief object of these operative methods was a rapid anatomical correction of the club-foot deformity, without giving much thought to the future function of the foot.

It must be admitted that most club feet are improved somewhat in appearance by forcible manipulations and operations, and occasionally a foot is restored to almost normal appearance with very little functional impairment. However, when a series of these cases, in which operations had been performed by the author and by others, were followed for a number of years and studied critically, it was found that there were many relapses, and that many patients had stiff, rigid feet, a few of which were more disabling than the original deformity.

After reviewing the literature and studying a series of operative cases, it seemed that if progress were to be made in the treatment of club-foot, it would not be made by devising a new operation, or by doing more accurately the operations which had already been devised, but that it would be by a method which did no harm to the foot, and which caused no adhesions in the many joints of the foot.

Inspired by a clearer understanding of the mechanics of the foot as taught by Dr. Michael Hoke, as well as by his meticulous attention to details in the application and molding of the cast, the writer followed the principles which Dr. Hoke recommended, and finally obtained a good correction of a club foot, without resorting to any operative procedures. The treatment extended over a long period of time, but the surprisingly good functional result repaid for the additional time and effort. During the past fifteen years the author has personally treated over 400 patients

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 17, 1939.

with club feet. The observations made here are based on a study of this group.

The writer has previously shown roentgenograms of cases where all



FIG. 1

Section of a joint removed from a recurrent club foot which had had several forcible manipulations previously. Fibrous and bony adhesions can be seen crossing from the cartilage of one bone to the other, causing an ankylosis of the joint and preventing further correction by the non-operative method.



FIG. 2-A



FIG. 2-B

This patient has had two operations on the medial side of the right ankle for the correction of club-foot deformity. The tibial epiphysis was injured, and has fused, causing the foot to be turned inward in a varus position.

the bones in the posterior foot had fused to each other and to the tibia, following forcible manual manipulations under an anaesthetic. Such extensive ankylosis is not the rule. However, when any force is used in manipulating a foot, some injury is done to the joints in the foot. The cartilage is often cracked, and the bones are partially crushed, forcing bone cells into the joint spaces. When the foot is held for a month or two in plaster casts following the manipulation, it is not surprising that fibrous ankylosis, or often bony ankylosis, occurs.

A microscopic study of some of these joints following forcible manipulations of the feet has been made by Dr. Everett L. Bishop. These joints were removed when operation was done later for correction of the deformity. (See Figure 1.) He states: "This condition may be described as

a chronic, non-infectious, inflammatory reaction due to pressure, with organization of the tissue and fusion of the bones—first by fibrous connective tissue, later by some new ossification—the bones finally becoming fused together into a fibro-osseous mass."

Another type of injury which may follow operative treatment is illustrated by a patient under treatment at the present time. This boy had had an operation on the medial side of the ankle and foot when he was a year old. When he was two and a half years old the deformity had recurred, and another surgeon did a similar operation at the same point. The distal tib-

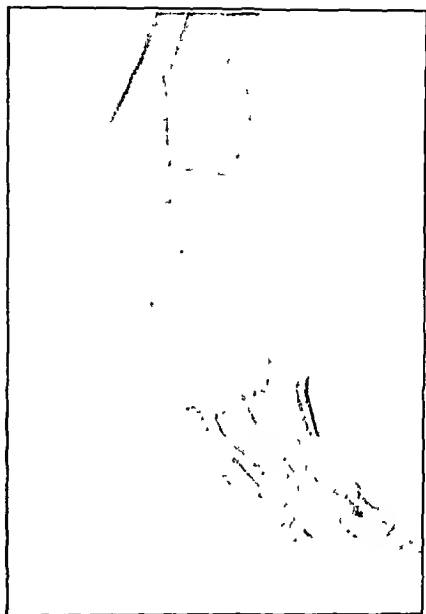


FIG. 3

Roentgenogram of the patient in Figs. 2-A and 2-B, taken at the age of four years, showing fusion of the distal epiphysis of the tibia. Notice the shortening of the tibia, as compared with the fibula.



FIG. 4

Roentgenogram of patient shown in Figs. 2-A, 2-B, and 3, taken at age of five and one-half years. Notice the increased shortening of the tibia as compared with the fibula. The cessation of growth in the tibia causes the foot to be turned inward, in an inverted position. This shows the harm done by one type of operation.



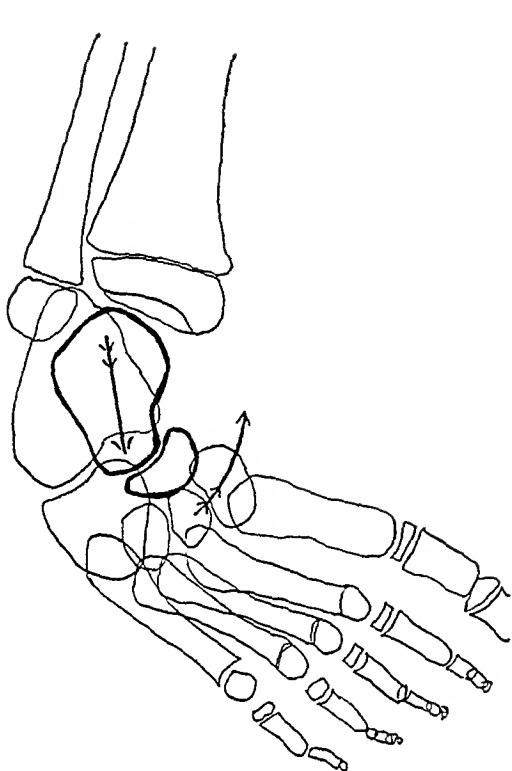


FIG. 5-A

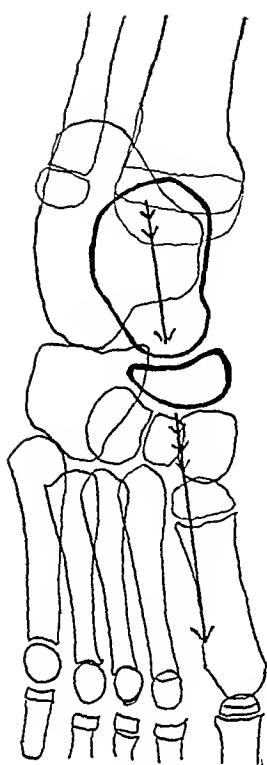


FIG. 5-B

Tracings made from roentgenograms of the right foot of a seven-year-old girl, before and after correction of club-foot deformity by plaster casts and wedgings. The roentgenogram made before treatment shows that the weight thrust of the body coming down the tibia is transmitted forward through the astragalus, strikes obliquely on the side of the navicular, and pushes the forefoot around in adduction. When the adduction deformity of the forefoot has been completely corrected, this weight thrust is transmitted straight forward from the astragalus through the navicular to the toes, as shown in the tracing of the roentgenogram made after correction of the forefoot adduction. If the wedging of the forefoot in abduction is stopped before the navicular is directly in front of the head of the astragalus, the deformity will recur when weight-bearing is permitted, because the weight thrust will fall obliquely on the navicular.

ial epiphysis was injured and later it fused. (See Figures 2-A and 2-B. Roentgenograms made at the ages of four (Fig. 3) and five and a half years (Fig. 4) show that the fibula has continued to grow, while growth has ceased in the lower end of the tibia. The foot is being forced around in varus, and the deformity is increasing with time.

Space does not permit a long summary of the harm that may come to a foot following operative procedures, but many examples can be found in the relapsed cases brought to any club-foot clinic.

Club-foot deformity may be divided into three parts: adduction, inversion, and equinus deformities. The forefoot is *adducted* when compared with the posterior foot. The os calcis is rotated inward under the astragalus, causing the entire foot to assume an *inverted* position. The *equinus* deformity may be divided into two parts: the forefoot is plantar-flexed when compared to the posterior foot, giving "forefoot

equinus"; the entire foot is plantar-flexed in the ankle joint, giving "ankle equinus". Each of these three deformities must be completely corrected, and in the order mentioned.

When the forefoot *adduction* is corrected, the navicular, which was medial to the head of the astragalus, is drawn around in front of the head of the astragalus (Fig. 5-B). The weight thrust down the tibia is transmitted through the astragalus to the navicular and straight forward to the toes. If an attempt is made to dorsiflex the foot before the navicular is in the proper position, the latter will be forced up on the medial side of the head of the astragalus. If much force is used, the navicular may become fixed on the medial side of the head, and later it will be found very difficult to move. If the navicular is still on the medial side of the head, when the treatment is discontinued and the child is allowed to walk, the weight thrust will fall obliquely on the side of the navicular, and push the forefoot back into the adducted position. Figure 5-A shows the mechanics of this, and explains why forefoot adduction recurs when it has not been completely corrected. If the forefoot is carried outward too far, the navicular may be drawn around lateral to the head of the astragalus into a flat-foot position, which is undesirable. Care should be exercised to correct the adduction deformity completely without overcorrecting it.

Correction of the *inversion* deformity is of sufficient importance to justify a more detailed discussion. The value of thoroughly correcting this deformity was not fully appreciated until about five years ago, when a study was being made of a series of cases of recurrent club-foot. The original photographs and roentgenograms in these recurrent cases showed no unusual inherent deformity that might account for the relapse. The importance of the correction of the inversion deformity was realized during the treatment of the following two cases.

A five-year-old girl with bilateral club-foot, the correction of which had previously been attempted elsewhere, was treated with a series of plaster casts and wedgings. The feet appeared to be well corrected when she was dismissed (Fig. 6). A few months later she returned, walking on the lateral border of each foot. Roentgenograms made on dismissal (Fig. 7) were thought at that time to have shown a satisfactory correction. It was later realized that the author's

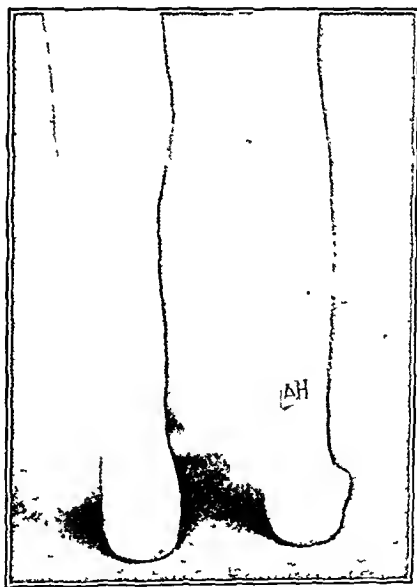


FIG 6

Posterior view of feet of a five-year-old girl whose club feet were corrected by the non-operative method. The heels seem to be straight under the mid-line of the tibia. Clinically, the inversion deformity has been corrected.

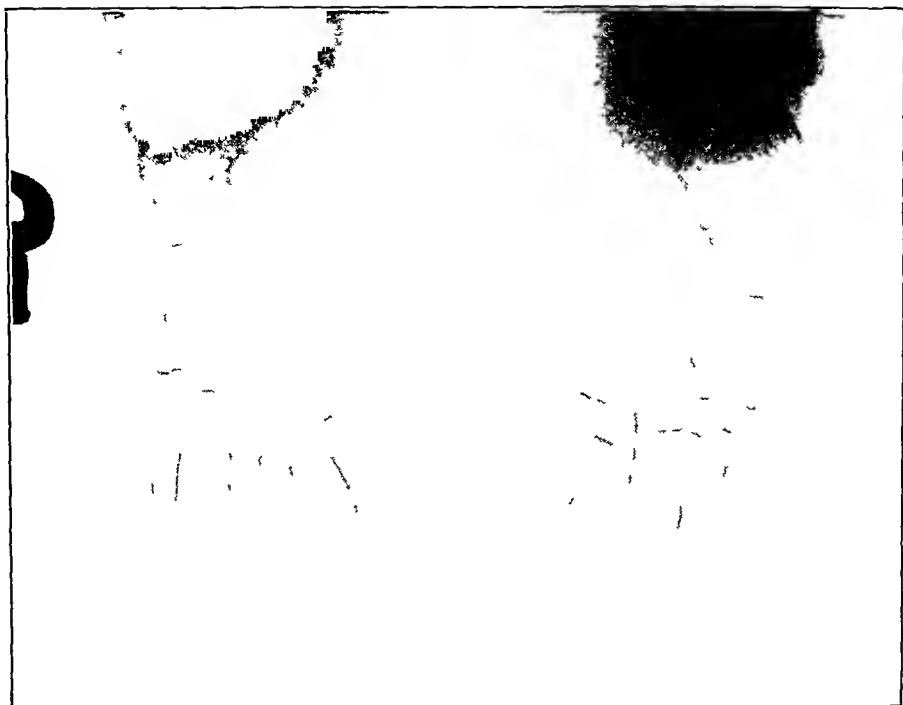


FIG 7

Roentgenograms of feet shown in Fig 6, taken after correction of the club-foot deformity. The inversion deformity has not been corrected, because the anterior end of the os calcis is still rolled in under the head of the astragalus. The shadows of the anterior ends of these two bones are superimposed instead of being separated normally



FIG 8

Originally both feet were clubbed, and the deformity was corrected by the non-operative method. The correction was maintained in the right foot, in the left,

Fig. 8 (*continued*)

the deformity recurred. This roentgenogram shows the reason for the recurrence. The anterior end of the os calcis is under the head of the astragalus, while on the right the two shadows are separated in the normal manner. There is still an inversion deformity of the posterior foot on the left. (*Courtesy of Surgery, Gynecology and Obstetrics.*)

interpretation was in error and that the roentgenograms really showed that the inversion deformity had not been corrected.

At about this same time, another girl with bilateral club-foot, who had been treated with casts and wedgings, returned for observation. She placed the right foot in the normal position, but walked on the lateral border of the left foot. The anteroposterior roentgenogram (Fig. 8) showed that the inversion deformity of the posterior foot had been corrected on the right, but that it had not been corrected on the left.

The inversion deformity is recognized in the anteroposterior roentgenogram by the fact that the os calcis is rolled in under the astragalus, so that the shadow of the anterior end of the os calcis is directly under the shadow of the head of the astragalus. When the inversion deformity is corrected, the os calcis is rolled outward to its normal position, so that the anterior ends of the two bones are separated. The mid-line of the astraga-



FIG. 9

Roentgenograms of feet shown in Fig. 8 a few weeks later after the inversion deformity had been corrected on the left. This is determined by the fact that the shadows of the anterior end of the os calcis and the head of the astragalus are separated in the normal manner. The equinus deformity was then easily corrected, and the correction has been maintained for more than five years. (*Courtesy of Surgery, Gynecology and Obstetrics.*)



FIG. 10-A



FIG. 10-B



FIG. 10-C



FIG. 10-D

Roentgenograms of a girl, three and a half years old, taken on admission. The patient had had a previous course of treatment elsewhere. The roentgenograms show that the deformity is about the same on the two sides.

lus then points toward the first and second toes, and that of the os calcis toward the fourth and fifth toes.

The left foot of the second patient mentioned was wedged in eversion until the inversion deformity had been corrected (Fig. 9), and then the foot was easily brought into dorsiflexion. The patient was seen recently,



FIG. 11-A

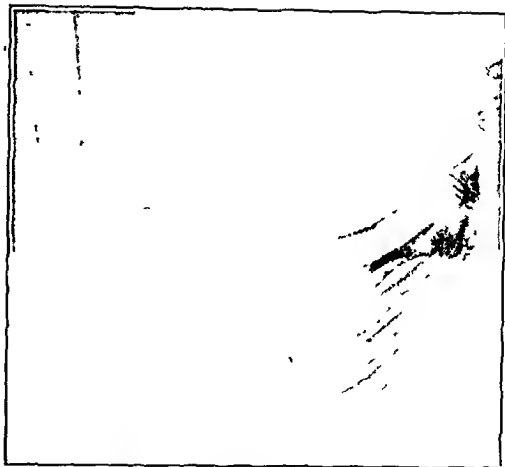


FIG. 11-B



FIG. 11-C

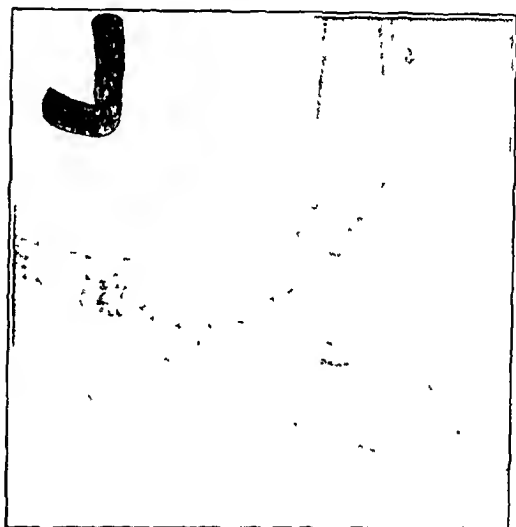


FIG. 11-D

Roentgenograms of patient shown in Figs. 10-A, 10-B, 10-C, 10-D, after the feet had been wedged in dorsiflexion. The right foot yielded in the mid-tarsal joint, giving a "rocker bottom" to the foot, while the left foot came into position without breaking in this joint. The antero-posterior roentgenograms show that the shadows of the anterior end of the os calcis and head of the astragalus on the right are superimposed, while on the left they are separated in the normal manner. The inversion deformity has not been corrected on the right, which accounts for the difficulty in bringing the foot into dorsiflexion.

some five years after the last treatment, and the correction of the deformity is well maintained.

There was another child under treatment at the same time, who had bilateral club-foot. When the feet were wedged in dorsiflexion, the right

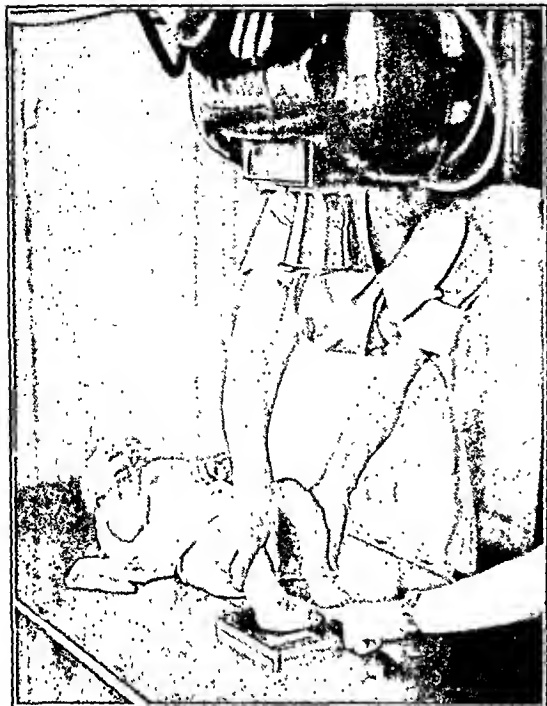


FIG. 12

Fig. 12

In taking a roentgenogram of club feet the central ray is directed straight down. The knees are held together and must be straight up, and not allowed to tilt to either side. The feet are held flat on the film by the great toes, as this does not cover up the part of the foot which is to be examined. The holding of the feet should always be done by the parents, so that no one individual will get too much exposure to the x-rays. In making the exposure the kilovolts should be increased, so that the exposure is a quarter of a second or less. It is difficult to keep crying babies still for a longer time. A five by seven film is large enough.

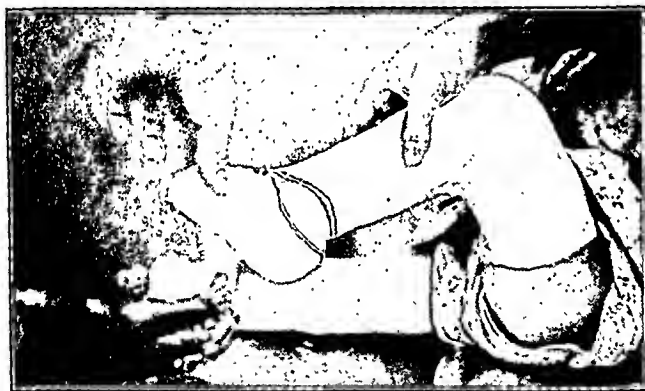


FIG. 13-A

Figs. 13-A and 13-B

Method of wedging the foot in eversion. A wedge-shaped portion of plaster is removed about the level of the lateral malleolus; the cut in the plaster is carried all the way around the ankle, freeing the two segments. The base of the wedge is on the lateral border. A plaster bandage is started on the medial side of the lower leg, about halfway between the knee and ankle, and brought around under the heel and up the lateral border of the leg. The foot is everted, and tension on the bandage holds the foot in eversion. The bandage is then carried around the leg in circular turns to hold the first turns to the cast, and to fill in the area where the wedge has been removed.



FIG. 13-B

foot was very difficult to bring into this position, and a "rocker bottom" developed in spite of the use of great care in applying and wedging the casts. The left foot came into dorsiflexion without difficulty, and without breaking in the mid-tarsal joint. Figure 10 shows no great difference in the appearance of the feet at the beginning of the treatment. Figure 11 shows the roentgenograms at the time when difficulty was experienced in bringing the right foot into dorsiflexion. The anteroposterior view of the resistant right

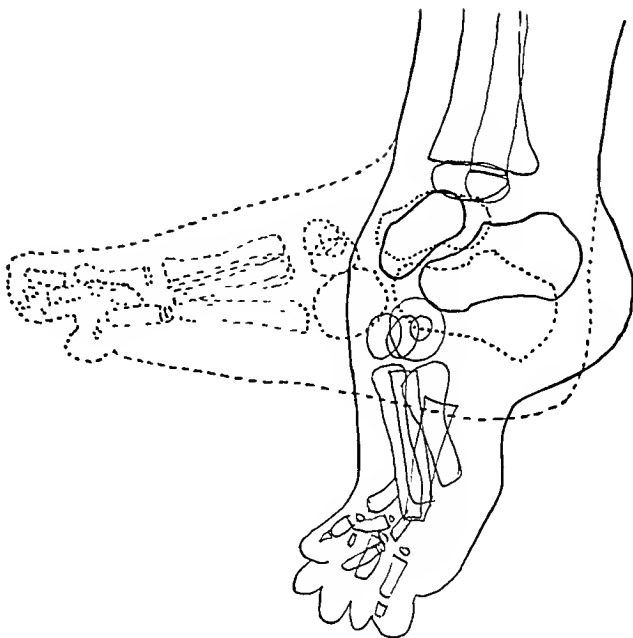


FIG. 14

Traceings of superimposed roentgenograms of the foot of a four-year-old boy, before and after correction by plaster casts and wedgings. The astragalus has been forced back under the tibia, and the os calcis has been drawn forward under the astragalus. The forefoot equinus and ankle equinus have both been corrected.

foot shows that the inversion deformity has not been corrected. The inversion deformity has been corrected on the left, and this foot could be brought into dorsiflexion with little difficulty. The right foot was plantarflexed, as this is necessary to relax the subastragalar joint, and then wedged in eversion. Later it came into dorsiflexion without difficulty, and without producing a "rocker bottom", and the correction has been maintained in both feet for more than five years.

For the last five years it has been the author's custom to take anteroposterior roentgenograms of all feet after the forefoot adduction and the inversion deformity appear to be corrected. (See Figure 12.) If the inversion deformity appears to be corrected, the foot is ready to be brought into dorsiflexion. If the astragalus and os calcis are separated, the heel should be wedged in eversion as shown in Figures 13-A and 13-B.

The *equinus* deformity is corrected by gradually bringing the foot into dorsiflexion. The anatomists tell us that the chief motion in the subastragalar joint is rotation,—that is, in eversion and inversion. When a club foot is brought into dorsiflexion, there seems to be a gliding forward motion also in the subastragalar joint. The os calcis is drawn forward, as shown in Figure 14. Lateral roentgenograms before treatment frequently show the astragalus extending forward over the os calcis by half the length of the astragalus, while, at the completion of the treatment,



the anterior ends of the two bones are on the same level. At the same time the body of the astragalus is pushed backward under the tibia, restoring the normal relationship between the bones.

Pressure upward on the forefoot, with the heel in inversion, only binds together more tightly the os calcis and the astragalus, so that the deformity can never correct itself spontaneously. When more pressure is used and the treatment is continued, the transverse tarsal joint yields, and continued force fails to correct the inversion and equinus deformities of the posterior foot. If the condition is not recognized, and if the foot is held for a long period in dorsiflexion with the os calcis in inversion, adhesions form between the os calcis and the astragalus, binding the two bones together so tightly that they cannot later be rotated to the normal position without operation. In such cases, at the time of operation, it is difficult to introduce a periosteal elevator into the subastragalar joint, because of the adhesions.

A study of these feet seems to substantiate the following statements: When continued pressure is made on the bones forming a joint, in such a direction that the joint can move, little harm is done to the joint. When the direction of the force is such that the joint cannot move, or that the motion is blocked, the pressure causes atrophy, and, if the pressure is continued, the trauma will produce adhesions in the joint. Later, if force is applied correctly, the deformity frequently cannot be corrected, because of the adhesions which bind the bones together. It is for this reason that recurrent club-foot is often more difficult to correct than untreated club-foot. For the same reason we should be sure that the adduction and inversion deformities are thoroughly corrected before beginning dorsiflexion.

The details of the application of the casts and the method of wedging the casts have been published, so they need not be repeated here. Ninety per cent. of all cases of club-foot which the author has treated have been corrected by plaster casts and wedgings. The remaining 10 per cent., composed chiefly of older children and patients who had been treated previously by operative procedures, were corrected by a Hoke club-foot stabilization. The non-operative method is recommended, because it does no harm to the foot, preserves function, and restores the foot to a normal appearance.

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## SURGICAL TREATMENT OF JOINT TUBERCULOSIS \*

BY MATHER CLEVELAND, M.D., NEW YORK, N. Y.

In October 1935, the author published a report <sup>1</sup> of 210 cases of joint tuberculosis, treated surgically on the orthopaedic service of Sea View Hospital during the years 1924 to 1931. It has seemed advisable to check that former report by the addition of another 100 consecutive cases, bringing the total to 310 patients treated over a ten-year period ending approximately January 1, 1935. This present report, somewhat in the nature of a supplement, will omit much of the detail of the former. Contrasts between the two series will be commented upon, and the more important conclusions will be emphasized.

There still seems to be a singular failure to consider patients with joint tuberculosis from the standpoint of their general infection with the disease. This aspect of the subject is so important that the failure to attempt some broad classification of these patients according to the severity of their infection with tuberculosis seems utterly careless. Because of this failure to grasp the fact that the patient with joint tuberculosis lives or dies according to the severity and extent of the disease and his reaction to it, no two series of patients reported, regardless of treatment, can be compared. It is foolish to attempt any comparison of a group of patients treated with rest and sunlight only with a similar number of patients treated by surgery, unless a uniform classification of types or degrees of the disease is recognized and utilized in each instance.

In order to formulate any classification of these patients, time and careful study are necessary. Very complete physical examination, roentgenographic examination of lungs as well as involved joints, sputum examination at frequent intervals, and in children, who often swallow their sputum, examination of gastric contents, are all primarily required. The cardiovascular, genito-urinary, and gastro-intestinal systems should be thoroughly investigated on the slightest suspicion of trouble. In the earlier report, a classification of these patients was suggested, in which the patients were divided into four groups. This is not iron-bound and unchanging, as a patient may and sometimes does change from one group to another over a period of years. The same classification has been adhered to in this report, because it has proved simple and useful. The groups have been rearranged in the order of the extent of the disease, progressing from minimal toward maximal involvement. This attempt to classify these patients is presented not in any sense dogmatically, but rather in the hope that if there is a better and simpler means it may be brought forward. These four groups (Table I) are as follows:

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 17, 1939.

TABLE I  
MORTALITY IN RELATION TO EXTENT OF SYSTEMIC TUBERCULOUS INFECTION

	Group A	Group B	Group C	Group D
	Patients with no evidence of pulmonary tuberculosis	Patients with pulmonary tuberculosis and negative sputum, with no metastatic spread to other organs	Patients with pulmonary tuberculosis and positive sputum	Patients with pulmonary tuberculosis and negative sputum, with metastatic spread to other organs
Entire series:				
Patients.....	89	80	89	52
Deaths.....	10	6	36	32
Mortality per cent.....	11.2	7.5	40.4	61.5
Tuberculosis of the spine:				
Patients.....	53	50	40	30
Deaths.....	7	4	16	20
Mortality per cent.....	13.2	8.0	40.0	66.6
Tuberculosis of the knee joint:				
Patients.....	10	15	21	11
Deaths.....	1	0	9	6
Mortality per cent.....	10.0	0.0	42.8	54.5
Tuberculosis of the hip joint:				
Patients.....	11	10	11	3
Deaths.....	2	1	5	3
Mortality per cent.....	18.1	10.0	45.4	100.0
Tuberculosis of the sacro-iliac joint:				
Patients.....	5	3	6	9
Deaths.....	1	0	4	3
Mortality per cent.....	20.0	0.0	66.6	33.3
Tuberculosis of the tarsal joints:				
Patients.....	5	2	6	3
Deaths.....	0	0	3	0
Mortality per cent.....	0.0	0.0	50.0	0.0
Tuberculosis of the ankle joint:				
Patients.....	4	0	2	0
Deaths.....	0	0	0	0
Mortality per cent.....	0.0	0.0	0.0	0.0
Tuberculosis of the upper-extremity joints:				
Patients.....	3	6	5	4
Deaths.....	0	0	0	1
Mortality per cent.....	0.0	0.0	0.0	25.0
Tuberculosis of the symphysis pubis:				
Patients.....	1	0	1	0
Deaths.....	0	0	0	0
Mortality per cent.....	0.0	0.0	0.0	0.0
Multiple-joint group:				
Patients.....	12	17	13	22
Deaths.....	4	0	6	11
Mortality per cent.....	33.3	0.0	46.1	50.0

- A. Patients with no evidence of pulmonary tuberculosis.
- B. Patients with pulmonary tuberculosis and negative sputum, with no metastatic spread to other organs.
- C. Patients with pulmonary tuberculosis and positive sputum.
- D. Patients with pulmonary tuberculosis and negative sputum, with metastatic spread to other organs.

Group A, like Group C, is easily recognizable. It comprises eighty-nine patients who presented no evidence of pulmonary tuberculosis, and the mortality was 11.2 per cent. Deaths in this group occur usually from prolonged suppuration and amyloid disease.

Group B comprises eighty patients who showed physical signs and roentgenographic evidence of arrested pulmonary disease, with negative sputum, throughout their hospital stay. The mortality among these patients was 7.5 per cent.

Group C comprises eighty-nine patients who had positive sputum during their hospital stay. The mortality among these patients was 47 per cent. in the first fifty-three cases, but fell to 33 per cent. in the next thirty-six, making an average mortality for the entire group of 40.4 per cent. This astonishing improvement is due to the recent advances in collapse therapy in the treatment of pulmonary tuberculosis, and it constitutes the most hopeful note that can be sounded. There should be continuous improvement in the treatment of these patients with active pulmonary disease, who have joint involvement.

Group D comprises those patients who showed signs and roentgenographic evidence of pulmonary disease with negative sputum, but in whom metastatic spread of their disease had developed. Their situation is indeed serious. As a rule, the patients in this group are overwhelmed by the disease and are apt to succumb to it. At times they have multiple-joint involvement, tuberculosis of the gastro-intestinal tract or genito-urinary tract, tuberculosis of lymph glands, and finally miliary tuberculosis. This metastatic spread occurs in patients who have not been operated upon, in those awaiting operation, and in those upon whom surgery has been performed. Our experience refutes any contention that surgery is responsible for the spread. Unfortunately, there is no accurate or certain means of foretelling a metastatic spread of this type. There are fifty-two patients in this group with a mortality of 61.5 per cent. In the last 100 patients, we operated upon only twelve patients in whom there was present or later developed a metastatic spread of their disease, and 66 per cent. of them died. Surgery, for the most part, performed upon these malignantly invaded patients can only offer relief from pain.

Since Groups C and D present a combined mortality of 48.2 per cent., and Groups A and B a mortality of 9.5 per cent., it is obvious that the success of any form of treatment of joint tuberculosis and the survival of the patients will depend in a large measure, if not wholly, upon which of the above groups dominate in the series reported. If all the patients fall into Groups A and B, surgical triumphs can be glowingly recorded, while

TABLE II  
RACE OR NATIONALITY OF 310 PATIENTS IN RELATION TO MORTALITY

Race	Patients	Deaths	Mortality Per Cent.*
West Indian (chiefly Puerto Rican) . . . . .	44	17	38.6
Irish . . . . .	43	11	25.5
American Negro . . . . .	59	15	25.4
German . . . . .	20	5	25.0
American . . . . .	31	6	19.3
Italian . . . . .	48	8	16.6
Jewish . . . . .	17	2	11.7
Greek . . . . .	7	0	
Polish . . . . .	6	4	
Hungarian . . . . .	4	0	
Spanish . . . . .	3	2	
English . . . . .	3	1	
Czecho-Slovakian . . . . .	4	2	
Scandinavian and Finnish . . . . .	8	2	
Scotch . . . . .	2	2	
Canadian . . . . .	2	1	
French, Japanese, and Russian (2 each) . . . . .	6	6	
Lithuanian, Rumanian, Bulgarian (1 each) . . . . .	3		
Total . . . . .	310	84	27.1

\* Mortality not computed for groups under ten.

disaster awaits those who select their patients from Group D, and there is danger enough in Group C to make an indiscriminate selection of patients with positive sputum hazardous. The mortality in our series was 25 per cent. in the last 100 cases and 28 per cent. in the first 210, an average mortality of 27 per cent. One has only to recall that until recently patients with caseous pneumonic tuberculosis—that is, positive sputum—had a mortality of 68 per cent. within one year of admission to the hospital and that patients with metastatic spread of their disease almost invariably died, to realize that there has been tremendous salvage among these unfavorable groups.

If one is seeking solely to avoid unfavorable mortality figures, one should absolutely refuse to operate upon any patient with a record of positive sputum at any time or, above all, any patient with evidence of metastatic spread. Patients with sinuses should be accepted for operation with reservation. We have been both unable and unwilling to make such a rigid selection and have, therefore, been fortunate enough to offer aid and comfort to a reasonable percentage of these derelicts in Groups C and D. Our errors of judgment in selection have been in Group D. Many of those patients did not declare their group until after operation. A few were deliberately chosen, knowing their group. If these had all been rigidly refused surgery, our total mortality for the remaining 258 patients would have been 20 per cent., but the rejected patients' mortality would have been far above 61.5 per cent.

TABLE III

RELATIVE FREQUENCY OF INVASION OF THE VARIOUS JOINTS IN THIS SERIES

	No.	Per Cent.
<b>Weight-bearing joints:</b>		
Spine.....	173	52.4
Knee.....	57	17.2
Hip.....	35	10.6
Sacro-iliac.....	23	7.2
Tarsus.....	16	4.8
Ankle.....	6	1.8
Symphysis pubis.....	2	0.6
Total.....	312	94.5
<b>Non-weight-bearing joints:</b>		
Shoulder.....	3	0.9
Elbow.....	10	3.0
Wrist or carpus.....	5	1.5
Total.....	18	5.5

*End Results:* The estimate of end results in a disease such as tuberculosis is difficult, and we can only report on our patients as of their last examination, knowing that another year may bring them trouble due to their disease. Our difficulties in follow-up have lessened considerably, but a sizeable number of our patients drift out of the hospital into the vast metropolitan area and are lost to us. Some of these are residents and a considerable number are transients. The patients are referred from Sea View Hospital to St. Luke's Orthopaedic Out-Patient Department where we have followed some of them for many years. In classifying our end results, we have adhered to the former groups: (1) excellent; (2) uncertain; (3) died. The average follow-up period for 182 excellent results is forty-five months. The sixty-two patients with uncertain results have been followed for an average of twenty-four months, and those who died lived for an average period of nine months after operation. (See Tables V and VII.)

*Racial Susceptibility to Tuberculosis:* Whether such susceptibility actually exists or whether certain racial groups in the metropolitan area are overcrowded and live under conditions which predispose to tuberculosis may be debated. However, we find that the highest incidence is among the American negroes with a mortality of 25 per cent., while the West Indians, who are chiefly Puerto Ricans, show the third highest incidence with a mortality of nearly 40 per cent. This seems very significant. (See Table II.)

*Joints Involved:* These 310 patients had 330 joints invaded with tuberculosis, which were treated surgically. Of these, 94.5 per cent. were the weight-bearing joints, and 5.5 per cent. were upper-extremity joints. Over half the incidence is in the vertebral joints. The fact that weight-bearing joints are invaded in such overwhelming proportion makes

TABLE IV  
INCIDENCE OF POSITIVE DIAGNOSIS PROVED BY TISSUE EXAMINATION  
OR GUINEA-PIG INOCULATION

Joints Operated Upon	Total No.	No Proved Positive
Spine	173	16
Knee	57	45
Hip	35	28
Sacro-iliac	23	17
Tarsus	16	8
Ankle	6	5
Symphysis pubis	2	0
Upper extremity	18	18
Total	330	137

us feel that small traumata must play some predisposing part in the invasion of joints by the tubercle bacillus. (See Table III.)

*Diagnosis:* We still feel that, if possible, an exact diagnosis should be made. This can usually be done, except in the spine where the area of disease is removed from the operative field, and only by aspiration of an abscess or removal of a chance bit of tissue can the diagnosis be proved. In 121 of 157 available joints (77 per cent.) the diagnosis was proved by study of tissue or exudate removed. It was also proved in sixteen of 173 spines. (See Table IV.)

*Principles of Treatment:* These are essentially the same as outlined in the former report. We treat each patient for general tuberculosis with prolonged rest before and after operation. Surgical treatment of the joint involved aims to accomplish either (1) complete rest of that joint, and at present operative fusion represents the most effective means to accomplish this, or (2) surgical removal by amputation of an extremity joint which is so overwhelmingly involved that salvage is impossible and any attempt to save it endangers the patient's life. The only joint for which we have tried and recommend resection is the elbow joint. A close cooperation between the physician and the surgeon is essential to ensure a reasonably effective and proper selection of candidates for surgical treatment.

#### TUBERCULOSIS OF THE SPINE

There were 173 patients with tuberculosis of the spine treated surgically, an incidence of 52.4 per cent. of the joints involved. Among these patients the vertebrae were involved from the atlas to the sacrum, but the peak of involvement extended from the seventh thoracic to the fourth lumbar with the maximum at the eleventh thoracic. (See Figure 1.) The disease in the thoracolumbar and lumbar area caused a slightly higher mortality than when it occurred elsewhere.

Paraplegia occurred in 30 per cent. of the first 110 patients with

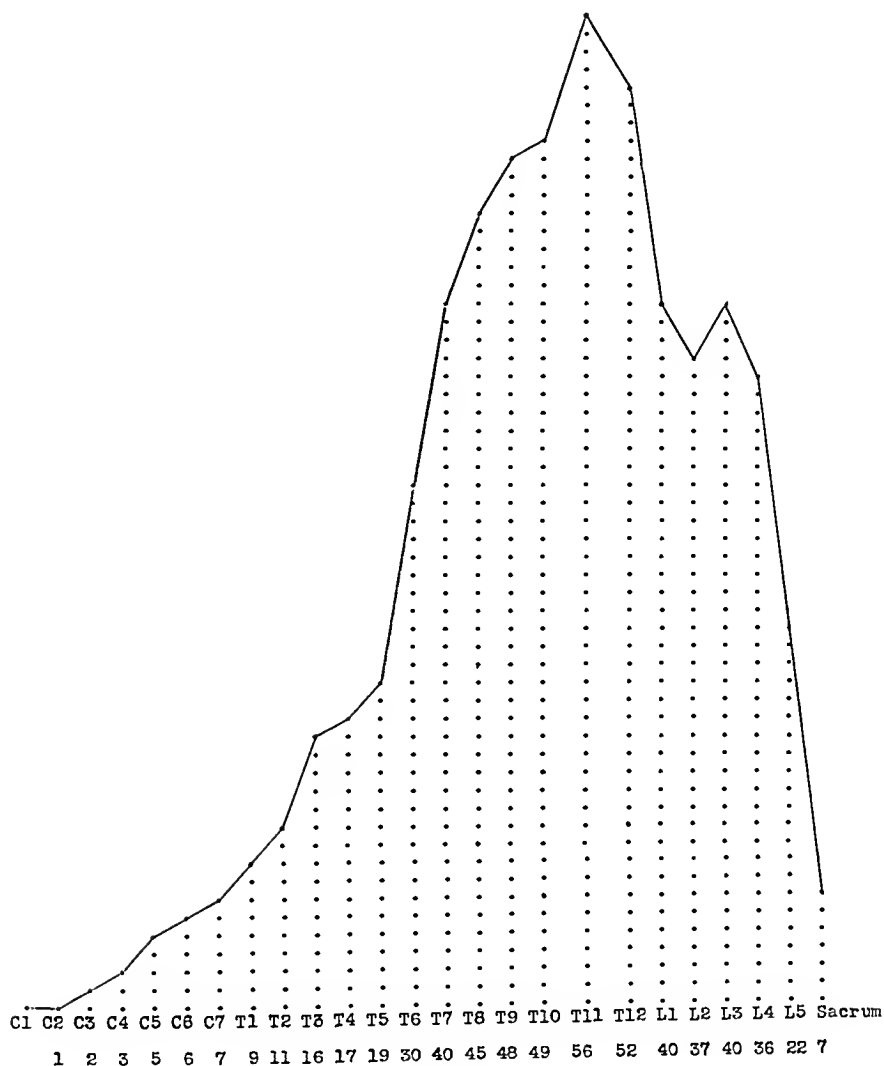


FIG. 1

Vertebrae involved in the series of 173 patients operated upon.

tuberculosis of the spine, and in only 11 per cent. of the next sixty-three. This is due to our former experience of a mortality of 48 per cent. in those patients in whom this evidence of cord pressure develops. To date our experience leads us to feel that a spine fusion with prolonged rest in bed is the best treatment in these cases.

Spontaneous fusion was found in a total of 24 per cent. of the patients with tuberculosis of the spine. Its extent varied from two vertebrae to eight or ten and took an average of six years to occur. In those patients with large areas involved, there was invariably an enormous kyphos.

Pseudarthrosis or failure of fusion has been proved in eight cases, or about 5 per cent. There are a few others in which it was suspected, but the patients refused a second operation. The author believes that 8 or 9



TABLE V  
END RESULTS OF TUBERCULOSIS OF THE JOINTS

Rating	No. of Patients	Per Cent.	Average Time after Operation
Spine—173 Cases:			
Excellent.....	94	54.3	3 years, 2½ months
Uncertain.....	32	18.5	2 years, 5½ months
Died.....	47	27.2	11 months
Knee—57 Cases:			
Excellent.....	31	54.4	2 years, 8½ months
Uncertain.....	10	17.5	2 years, 1 month
Died.....	16	28.1	6 months
Hip—35 Cases:			
Excellent.....	18	51.4	6 years
Solidly fused.....	17		
With a few degrees of motion.....	1		
Uncertain.....	6	17.2	2 years, 6½ months
With solid bony fusion.....	4		
Not fused when last seen.....	2		
Died.....	11	31.4	14 months
With solid bony fusion.....	1		
Not fused.....	10		
Sacro-iliac—23 Cases:			
Excellent.....	10	43.5	4 years, 6 months
Uncertain.....	5	21.7	1 year, 8 months
Died.....	8	34.8	7½ months
Tarsus—16 Cases:			
Excellent.....	10	62.6	5 years, 6 months
Uncertain.....	3	18.7	4½ months
Died.....	3	18.7	6 months
Ankle—6 Cases:			
Excellent.....	5	83.3	4 years, 7 months
Uncertain.....	1	16.7	3 years
Died.....	0	0.0	
Upper Extremity—18 Cases:			
Excellent.....	12	66.6	5 years, 6 months
With solid fusion:			
Shoulder.....	3		
Elbow.....	2		
Carpus.....	4		
Amputation for tuberculosis of elbow.....	1		
Without fusion:			
Elbow.....	2		
Uncertain (elbow joint).....	5	27.8	6 months
Died (carpus).....	1	5.6	
Symphysis Pubis—2 Cases:			
Excellent.....	2	100.0	4 years, 6 months
Uncertain.....	0	0.0	
Died.....	0	0.0	
Multiple-Joint Group—19 Patients Who Had a Second Joint Operated Upon:			
Excellent.....	9	47.4	6 years, 9 months
Uncertain.....	7	36.8	8 months
Died.....	3	15.8	1 year, 1 month

TABLE VI  
MORTALITY IN THE VARIOUS AGE GROUPS AMONG 310 PATIENTS  
WITH ALL TYPES OF JOINT TUBERCULOSIS

Age Group	Total	Died	Mortality Per Cent.
1-10.....	61	11	18.0
11-20.....	56	14	25.0
21-30.....	94	33	35.1
31-40.....	46	13	28.2
41-50.....	38	9	23.6
51-60.....	12	4	33.3
Over 60.....	3	0	0.0
Total.....	310	84	27.1

per cent. would be a fairer figure. The patients are all carefully checked symptomatically and roentgenographically before they are allowed to get out of bed. We have had at Sea View Hospital a sizeable number of patients with spine operations done elsewhere, both by bone graft and by the Hibbs type of fusion, who had pseudarthrosis. The bone grafts were usually too short and not well anchored. Of these 173 cases of tuberculosis of the spine, there were excellent results in 54.3 per cent.; uncertain, in 18.5 per cent.; and death occurred in 27.2 per cent. (See Tables I, V, and VII.)

#### TUBERCULOSIS OF THE KNEE JOINT

Tuberculosis of the knee joint is, we still believe, the most favorable, or rather the simplest joint to treat surgically. Our experience in the first forty-four patients was very satisfactory with excellent results in 61 per cent. The next thirteen patients, however, were all in Groups C (ten) and D (three), with a resulting high mortality. Six of these thirteen patients had a mid-thigh amputation because of overwhelming infection with numerous sinuses. Each of these desperately ill patients was made comfortable, and two recovered from their disease, which we feel amply justified the procedure. If amputation had been done earlier, it is quite possible that others might have been saved. Of the total fifty-seven patients with knee-joint tuberculosis, there were excellent results in 54.4 per cent.; uncertain, in 17.5 per cent.; and 28.1 per cent. died. (See Tables I, V, and VII.)

#### TUBERCULOSIS OF THE HIP JOINT

This is a manifestation of joint tuberculosis which occurs at an earlier age than other types. Our thirty-five patients with this joint involvement showed the following age distribution: 37 per cent. under ten years of age, 57 per cent. under twenty, and 82 per cent. under thirty. The operative fusion of the hip with the head and neck of the femur intact is difficult technically, as the numerous procedures suggested will bear

TABLE VII  
COMBINED END RESULTS FOR 330 JOINTS INVOLVED

Joints Operated Upon	Excellent		Uncertain		Died		Total
	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	
Spine.....	94	54.3	32	18.5	47	27.2	173
Knee.....	31	54.4	10	17.5	16	28.1	57
Hip.....	18	51.4	6	17.2	11	31.4	35
Sacro-iliac.....	10	43.5	5	21.7	8	34.8	23
Tarsus.....	10	62.6	3	18.7	3	18.7	16
Ankle.....	5	83.3	1	16.7	0	0.0	6
Symphysis Pubis..	2	100.0	0	0.0	0	0.0	2
Upper Extremity..	12	66.6	5	27.8	1	5.6	18
Total.....	182	55.1	62	18.8	86	26.1	330

witness. With the joint badly disorganized, fusion is often impossible. From a technical standpoint, we have been fortunate to get solid bony fusion in twenty-one of our twenty-four surviving patients, or 87.5 per cent. Of the eleven who died, only one had a solid hip fusion. Our results with these patients are better than previously reported, because, with the passing years, several patients have moved from "uncertain" to "excellent" rating. Of these thirty-five patients, 51.4 per cent. had excellent results; 17.2 per cent., uncertain results; and 31.4 per cent. died. (See Tables I, V, and VII.)

#### TUBERCULOSIS OF THE SACRO-ILIAC JOINT

Our experience with the first sixteen cases of tuberculosis of the sacro-iliac joint led to the following observation: "Sacro-iliac joint tuberculosis is a serious manifestation with a mortality which is high for joint tuberculosis." Twelve out of these first sixteen patients were in Groups C and D. The next seven cases showed four patients in Groups A and B, with a correspondingly higher incidence of excellent results and lower mortality. Of the entire series of twenty-three patients, 43.5 per cent. had excellent results; 21.7 per cent., uncertain results; and 34.8 per cent. died. This is our least satisfactory record. (See Tables I, V, and VII.)

#### TUBERCULOSIS OF THE TARSAL AND ANKLE JOINTS

In these joints, if the lesion is encountered early, fusion can be used safely and efficiently, but if there is wide-spread destruction of the joint or joints and draining sinuses, amputation should be done promptly. We have done sixteen fusions and six amputations on these twenty-two patients with excellent results in 68.2 per cent., uncertain results in 18.2 per cent., and death occurring in 13.6 per cent. (See Tables I, V, and VII.)

## TUBERCULOSIS OF THE SYMPHYSIS PUBIS

In the former report it was suggested that fusion of both sacro-iliac joints might be used to immobilize a diseased symphysis pubis where there are draining sinuses. There was an opportunity to try this procedure, and it was entirely successful. The disease in the symphysis pubis healed after the sacro-iliac joints became solid. This patient was in Group C and recovered. Our two patients with tuberculosis of the symphysis pubis had excellent results. (See Tables I, V, and VII.)

## UPPER-EXTREMITY JOINT TUBERCULOSIS

This group shows a considerably higher percentage of excellent results (66.6 per cent.) and a low mortality (5.6 per cent.). Recently we have amputated a little more frequently in seemingly hopeless cases and have had one excellent result and three uncertain results, with complete relief of pain.

While a successful fusion of the elbow joint will arrest the disease, it is followed by more disability than in any other joint. For this reason, we have been doing resections of this joint in favorable cases. We cannot as yet draw any conclusions on these few cases. (See Tables I, V, and VII.)

## PATIENTS WITH MULTIPLE JOINT TUBERCULOSIS

Among the 310 patients, there were sixty-four in whom more than one joint was invaded with tuberculosis, excluding a second spine focus. Of these, only nineteen had a second joint treated surgically. As a rule, these patients showed a higher than average mortality and lower than average excellent results. Of those selected for surgical treatment, a small group with fairly high resistance, 47.4 per cent., had excellent results and only 15.8 per cent. died. (See Tables I, V, and VII.)

## SUMMARY

Again we have ample proof of our former statement that joint tuberculosis is essentially a disease of childhood and of early adult life. Table VI shows that 211, or 68 per cent., of our 310 patients were in the first three decades of life at the time of admission to the hospital. The highest mortality was in the third decade. We are still convinced that the disease is very serious and that the mortality is high.

Operative surgery is utilized in some instances, where possible, to eliminate by amputation a joint which cannot be salvaged or, more frequently, to put a joint completely at rest by fusion. In neither instance does surgery alone effect the cure. It may turn the tide in favor of the patient.

As we have shown, the patient's ultimate fate depends largely upon the type and extent of his infection with tuberculosis. The mortality of 48.2 per cent. among those patients in Groups C and D and 9.5 per cent. in those in Groups A and B should speak for itself.

The reduction in mortality from 47 per cent. in our former report to 33 per cent. in patients with tubercle bacilli in their sputum—that is, active pulmonary disease on entering the hospital—is a highly encouraging evidence of what collapse therapy for the lungs and surgery for the involved joint can accomplish.

The patient with the metastatic spread of the disease still presents a formidable barrier to brilliant statistical results. In the light of our experience, it must be considered foolhardy to attempt other than emergency surgery on those patients with evident metastatic spread.

The majority of the deaths in the more favorable groups are due to prolonged suppuration. Many of these, we feel, can be prevented by earlier operative intervention. The end results in this type of surgery are, for the most part, not brilliant. Of the 330 joints treated surgically, there were excellent results in 55.1 per cent., uncertain results in 18.8 per cent., and death occurred in 26.1 per cent. (See Table VII.) This work is definitely salvage, and we are glad to be able to restore to their homes and to such activities as they may resume over 50 per cent. of these patients. It is to be hoped that, with increasing knowledge of tuberculosis, the incidence of all forms of this disease will continue to decline sharply and that such surgery as is necessary may be done early, before the patient becomes dangerously ill.

1. CLEVELAND, MATHER: Surgical Treatment of Joint Tuberculosis. Surg. Gynec. Obstet., LXI, 503, 1935.

# A TECHNIQUE FOR LONGITUDINAL PIN FIXATION OF CERTAIN FRACTURES OF THE ULNA AND OF THE FEMUR

BY LESLIE V. RUSH, M.D., AND H. LOWRY RUSH, M.D., MERIDIAN, MISSISSIPPI

In November 1937 an operation for the reconstruction of comminuted fractures of the upper third of the ulna was described by us <sup>1</sup>, in which the olecranon was realigned with the shaft by means of a Steinmann pin introduced through the tip of the olecranon and passed axially into the medullary canal of the shaft, the comminuted bone fragments being fixed around this pin in the intervening gap by circular wires.

It is the purpose of this article to describe a new pin which has been designed for this purpose, and to report one case of fracture of the upper third of the femur in which the same principle was used with most gratifying results. Our experience with longitudinal pin fixation dates back over a period of several years. Since the technique of fixation in this case is but an adaptation of a method which has previously been used successfully in the fixation of fractures elsewhere in the body, we feel that it will be interesting to review briefly those cases which precipitated the idea of fixation by a longitudinal pin.

CASE 1. W. R. B., white, male, aged thirty-six, in 1932 suffered a comminuted fracture of the upper third of the ulna, anterior dislocation of the head of the radius, and severe soft-part damage, but without tearing of the skin. He was treated by open reduction. Since no satisfactory technique for fixing these fractures was available, a form of fixation was devised in which a beef-bone peg was passed obliquely through the olecranon and the shaft of the ulna. The head of the radius remained in position, and, although in this particular case fixation was satisfactory, external splinting was necessary for a prolonged period. This markedly delayed active motion, and, for many weeks after the operation, active and passive motion resulted in bending at the fracture site.

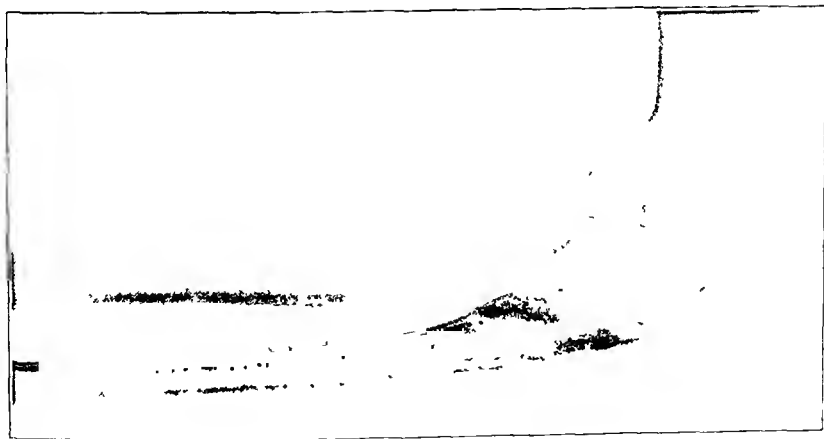


FIG. 1

Case 1. Six years after injury. Good flexion. Extension limited by dorsal bowing of ulna.

Consequently, the return of function to the elbow was markedly delayed. Good function was ultimately secured (Fig. 1).

CASE 2. I. B. V., white, male, aged forty-two, was seen in 1936 with a severe compound comminuted fracture of the upper third of the ulna with anterior dislocation of the head of the radius. There were severe lacerations and abrasions of the skin of this area. An alcohol compress was applied for two hours, followed by débridement and an open reduction of the fracture of the ulna. The fragments were held satisfactorily by passing a stainless-steel wire through a transverse drill hole in the shaft of the ulna and threading this over the tendon of the triceps muscle. The arm was immobilized in a plaster cast at an angle of 90 degrees. Check-up roentgenograms twenty-four hours after operation showed a recurrence of the anterior dislocation of the radius, carrying with it the shaft of the ulna, resulting in separation of the comminuted fragments (Fig. 2). An attempt at closed reduction of the dislocation by bringing the elbow into acute flexion resulted in an untwisting of the wire and marked separation of the fragments. The patient refused further treatment and could not be traced. This experience impressed upon us the

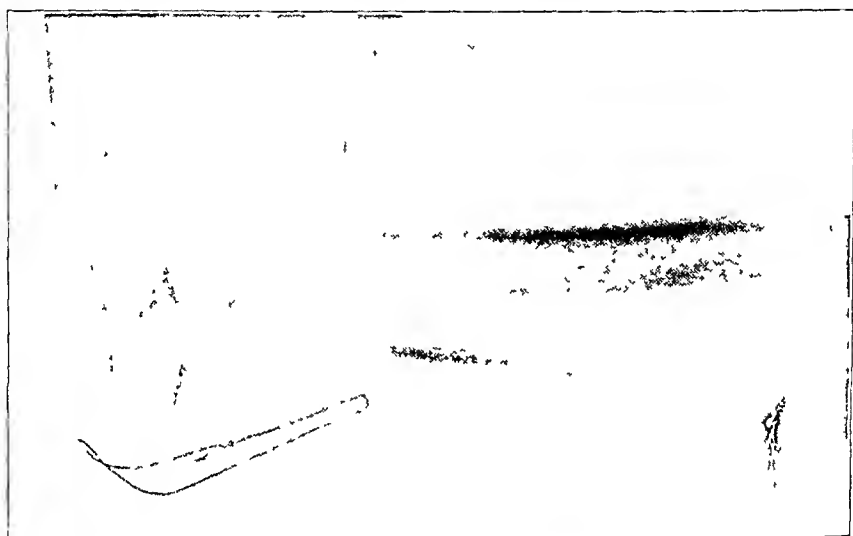


FIG. 2

Case 2. Showing the inadequacy of wire fixation.



FIG. 3

Case 3. Showing the perfect reconstruction made possible with longitudinal pin fixation.

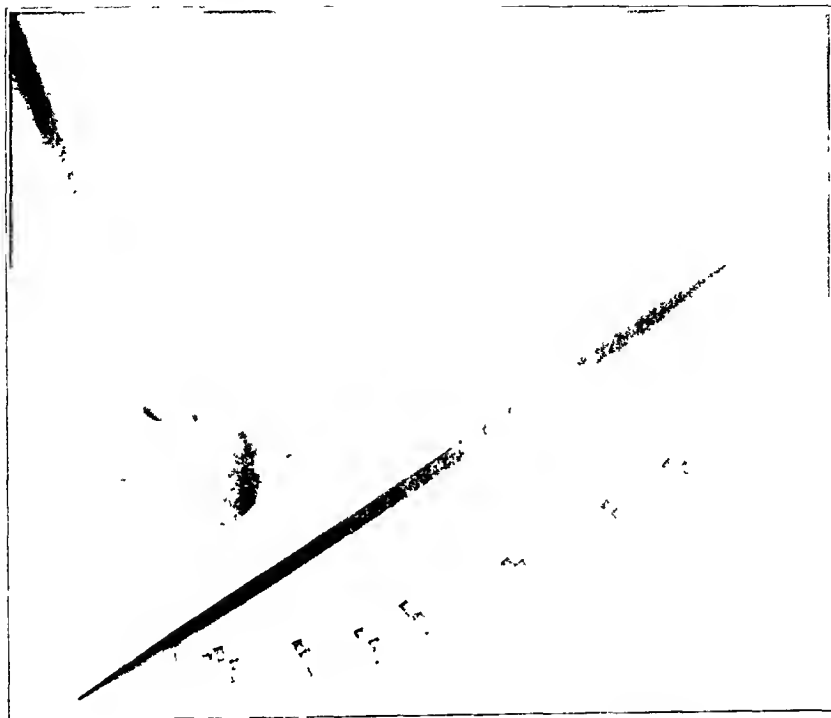


FIG. 4

Case 4. Fixation by longitudinal Steinmann pin.

necessity of some form of longitudinal rigid fixation.

CASE 3. K. B. R., colored, female, aged thirty-six, was seen in 1936 with a markedly comminuted fracture of the upper third of the shaft of the ulna and anterior dislocation of the head of the radius. She entered the Clinic one week after injury. At the time of admission there was a severe swelling at the elbow, and operation was deferred four days. Eleven days after the injury an open reduction was done, and a Steinmann pin was introduced longitudinally through the olecranon and threaded into the medullary canal of the shaft of the ulna. This reduced the dislocation of the head of the radius and held it firmly in place. The comminuted fragments were then replaced and fixed around the Steinmann pin in the intervening gap with circular wires of stainless steel. Check-up roentgenograms showed almost perfect anatomical restoration (Fig. 3). Myositis ossificans occurred anterior to the elbow joint, and a prolonged period of immobilization was required.



FIG. 5

Case 4. Showing motion at four weeks. Note pin protruding and covered by adhesive.



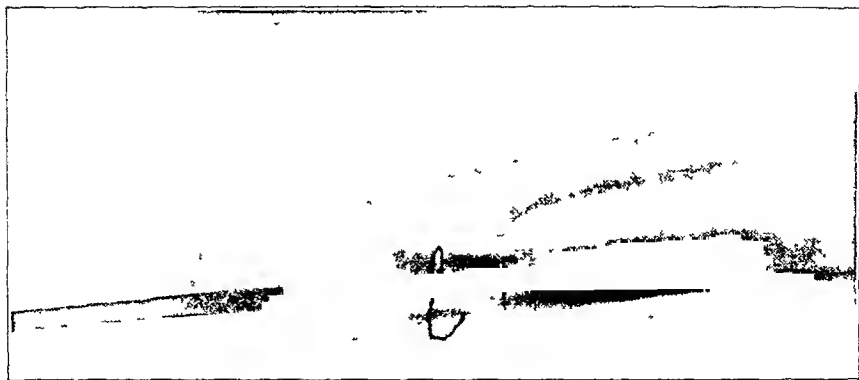


FIG. 6

Case 5. After operation.

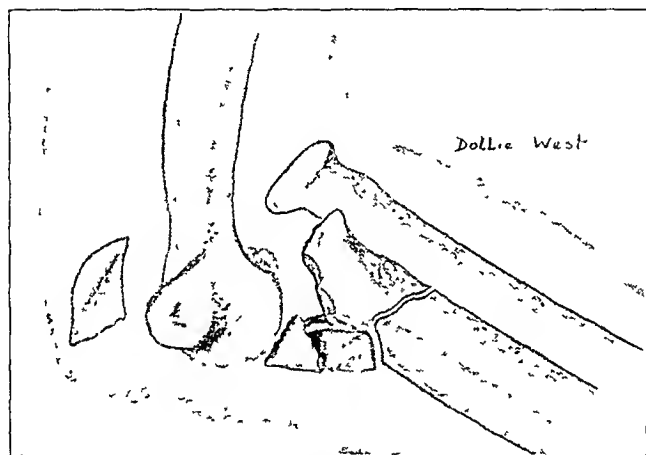


FIG. 7

Comminuted fracture of the upper third of the ulna, showing characteristic displacement of fragments and anterior dislocation of the head of the radius.

and was painless. Figure 5 shows motion four weeks after operation. At the end of eight weeks, union was secure enough to permit removal of the pin. The result in this case, both anatomically and functionally, was excellent.

**CASE 5.** Mrs. H. W. F., white, female, aged forty-six, was seen on December 1, 1938, immediately after having sustained a compound comminuted fracture of the upper third of the ulna with anterior dislocation of the head of the radius. There was severe contusion of the soft parts with a subcutaneous hematoma over the fracture site on the dorsum of the forearm. An alcohol compress was applied for two hours prior to operation. After débridement of the edges of the wound, an open reduction was done, using the authors' pin, a description of which follows this case report. No form of immobilization was used. The patient suffered practically no postoperative pain, and active motion was begun on the seventh day. At the time this paper was written, the pin was still in place (Fig. 6), and the patient had almost complete range of motion, which was painless.

In this type of case we have found that longitudinal pin fixation is technically simple, gives absolute mechanical fixation without the necessity of external immobilization, and, at the same time, makes it possible to reconstruct the shaft of the ulna by tying the loose bone fragments to

**CASE 4.** W. R. R., white, male, aged forty-two, was seen on May 14, 1937, with a comminuted fracture of the upper third of the ulna, dislocation of the head of the radius, and comminuted fractures of the head of the radius. An open reduction was done by the same technique used in Case 3, employing longitudinal Steinmann-pin fixation (Fig. 4). The fragments of the fractured radial head were removed. No form of immobilization was used. Active motion was begun in two weeks

the pin. (See Figures 7 and 8.) This rigid fixation of the ulna maintains the position of the head of the radius.

To meet adequately the needs of this operation we have had a special pin constructed (Fig. 9). This pin is a modification of the Steinmann type and is constructed of stainless steel. The proximal end is flattened on three sides to fit the clamp of a hand drill. Immediately distal to this portion is a collar to prevent the pin from slipping into the bone.

The structure of the shaft and distal extremity of the pin is identical with that of the Steinmann pin. Because of its applicability also in fractures of the upper third of the femoral shaft, it is made in several sizes, the overall lengths varying from five to twelve inches.

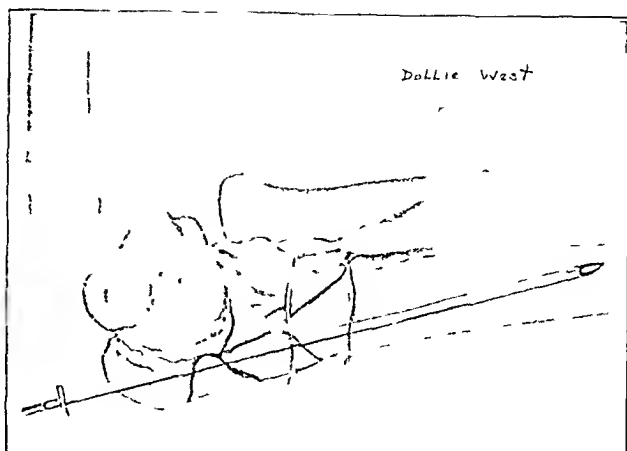


FIG. 8

Showing method of reconstruction with authors' pin.

#### TECHNIQUE OF OPERATION AS APPLIED TO THE FEMUR

With the patient in the dorsal position on the fracture table, the incision is made on the lateral side of the thigh, beginning about one and one-half inches above the greater trochanter and carrying it downward sufficiently low to expose the fracture site (Figs. 10 and 11). The fibers of the fascia lata are divided longitudinally, and the superior portion of the greater trochanter is exposed by splitting and separating the fibers of the gluteal muscle. The proximal fragment is grasped by forceps, and is

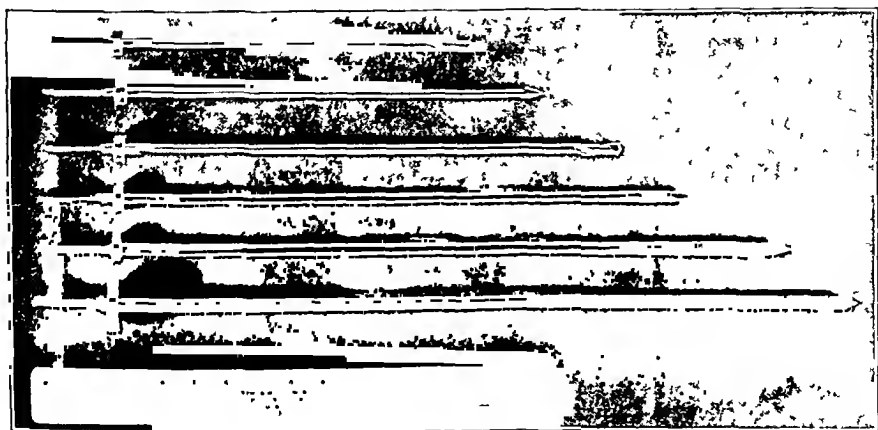


FIG. 9

The pins, showing the various lengths and diameters.

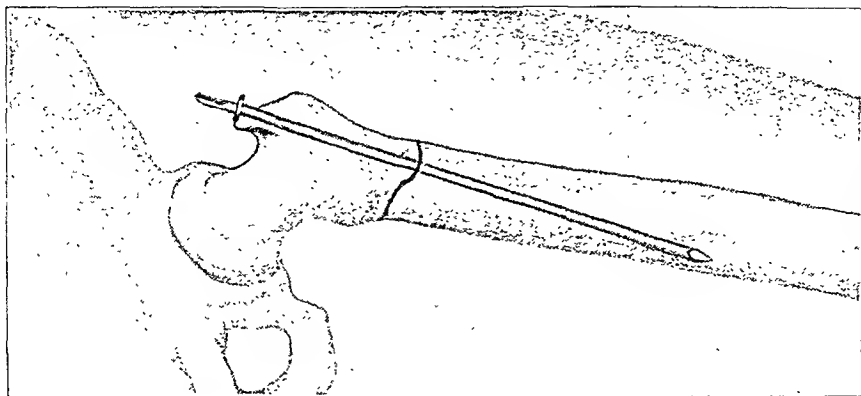


Fig. 12

Reduced subtrochanteric fracture of femur fixed by authors' pin.

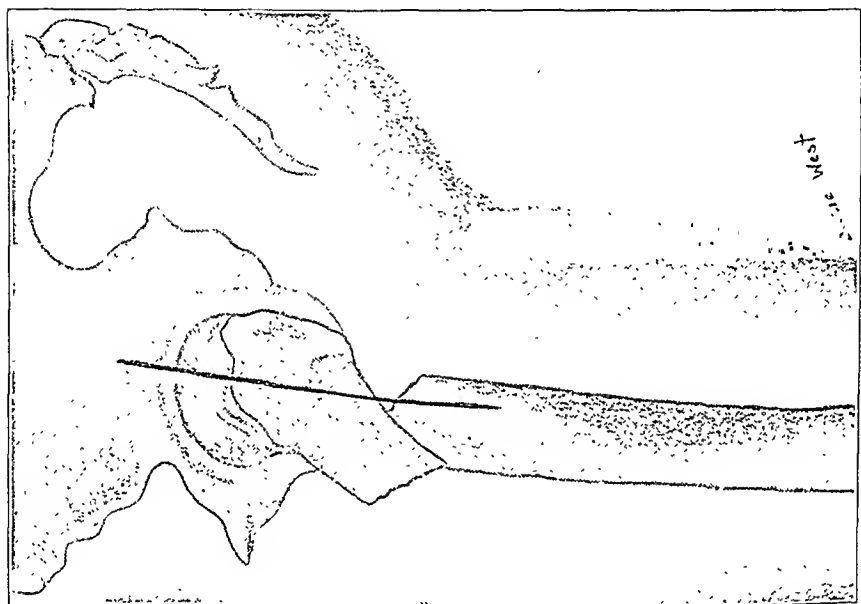


Fig. 11

Subtrochanteric fracture of femur, showing usual displacement and line of incision.

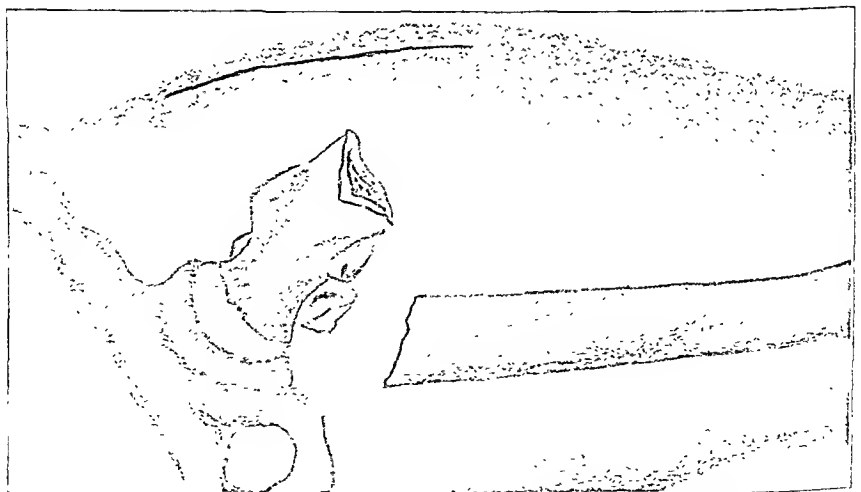


Fig. 10



FIG. 14

Case 6. After open reduction and longitudinal pin fixation.



FIG. 13

Case 6. Subtrochanteric fracture of right femur.

adducted and internally rotated by an assistant. The surgeon then fixes the pin in the drill, introduces the point into the superior portion of the trochanter, and passes it longitudinally with the axis of the upper fragment, so that the point extrudes at the fracture line through the central portion of the bone. The pin at this stage is drilled no farther than the fracture line. Guiding the upper fragment by the pin and the lower fragment by the forceps the surgeon accurately reduces the fracture, and the pin is passed down into the medullary canal of the shaft until the collar of the pin is in contact with the trochanter (Fig. 12). The wound is closed in layers, using No. 0 chromic catgut for the muscle and fascia lata and silkworm gut for the skin. A plaster cast is applied in the usual manner.

CASE 6. Mrs. T. B., white, female, aged thirty-nine, was seen on May 3, 1938, with a subtrochanteric fracture of the right femur with marked swelling and deformity (Fig. 13). There was marked abduction with external rotation of the upper fragment, and for many reasons neither closed reduction and a cast nor skeletal traction appeared to be indicated. An open reduction was decided upon. It was felt that the most satisfactory fixation could be secured by a longitudinal pin of the type which has been described. None of sufficient size and length was available. A satisfactory pin was constructed by a local machinist from a steel rod, twelve inches over-all, and a collar was welded to prevent the pin from slipping into the bone. When the incision was made, an oblique intertrochanteric fracture, not revealed by the roentgenogram, was found. Open reduction was done, and fixation was secured by passing the pin longitudinally through the long axis of the bone and introducing it through the superior portion of the greater trochanter into the medullary canal of the femur (Fig. 14). A plaster cast was applied, which was removed in six weeks. The pin was removed in the ninth week. It caused very little discomfort on active motion and was removed without difficulty.

#### DISCUSSION

This operation is applicable to certain fractures of the upper third of the shaft of the femur, subtrochanteric fractures, and certain intertrochanteric fractures. When the femur breaks below the trochanter, the upper fragment is flexed and abducted upon the trunk by the action of the iliopsoas muscles and the external rotators. The strong adductors hold the shaft medially. In this case the entire operation consumed thirty minutes. We found that the fixation was absolute, being strengthened by the strong pull of the adductors. There was no tendency to rotation, and the plaster cast could probably have been omitted. If the pin is sufficiently strong, the only necessity for a plaster cast is to prevent rotation. In many instances the patient could, no doubt, be made ambulatory soon after the operation, and in others active motion could be permitted by using some form of apparatus on the foot to hold it in an upright position. This would, no doubt, facilitate nursing and speed recovery of the patient, particularly in the case of aged individuals. There appears to be no technical difficulty in the insertion or removal of the pin.

#### REFERENCE

1. RUSH, L. V., AND RUSH, H. L.: A Reconstruction Operation for Comminuted Fracture of the Upper Third of the Ulna. *Am. J. Surg.*, XXXVIII, 332, 1937.

# ASTRAGALECTOMY AND THE TREATMENT OF CALCANEOVALGUS \*

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## INTRODUCTION

Forty years ago Royal Whitman began to use astragalectomy for the correction of paralytic deformity. The operation apparently was first done for a compound fracture by Fabricius of Hilden in 1608. It was, however, used only for fracture or disease of the astragalus until 1901, when Whitman published a report of thirteen cases of paralytic talipes of the calcaneus type in which the operation had been performed. The use of astragalectomy for the correction of foot instability and deformity has been a controversial subject ever since. Although it has not been generally accepted, its value in the treatment of calcaneus deformity has been recognized.<sup>7, 14, 19, 24, 25, 26</sup> It may be that some other procedure will be found to supplant it, just as methods of internal fixation are supplanting the Whitman abduction treatment of fracture of the neck of the femur. If any new procedure supplants an old one, it not only must be sound anatomically and functionally, but also must offer definite advantages over the old one.

In the past four years at the Hospital for the Ruptured and Crippled the author has encountered many old astragalectomies. There has been no preconceived prejudice either for or against the procedure, but the opportunity to observe such a large number of late results has prompted this report. A study of the records of the 2066 astragalectomies performed at the Hospital since 1895 has been made. This report, however, is based upon a series of 100 patients who were personally examined, photographed, and x-rayed. These cases have not been selected, but they represent the longest follow-up periods.

## CRITERIA FOR A SATISFACTORY FOOT STABILIZATION

In any paralyzed patient the possibilities for correction of deformity and improvement in function are limited. If the paralysis is at all extensive, transplantation of muscle power is practically useless. A satisfactory foot stabilization can greatly improve the function of an entire paralyzed extremity. To be ideal it should provide the following:

1. Even weight distribution upon the plantar surface during stance and gait;
2. Good lateral stability;
3. The axis of the ankle-joint well forward and at a right angle to the long axis of the foot;

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 18, 1939.

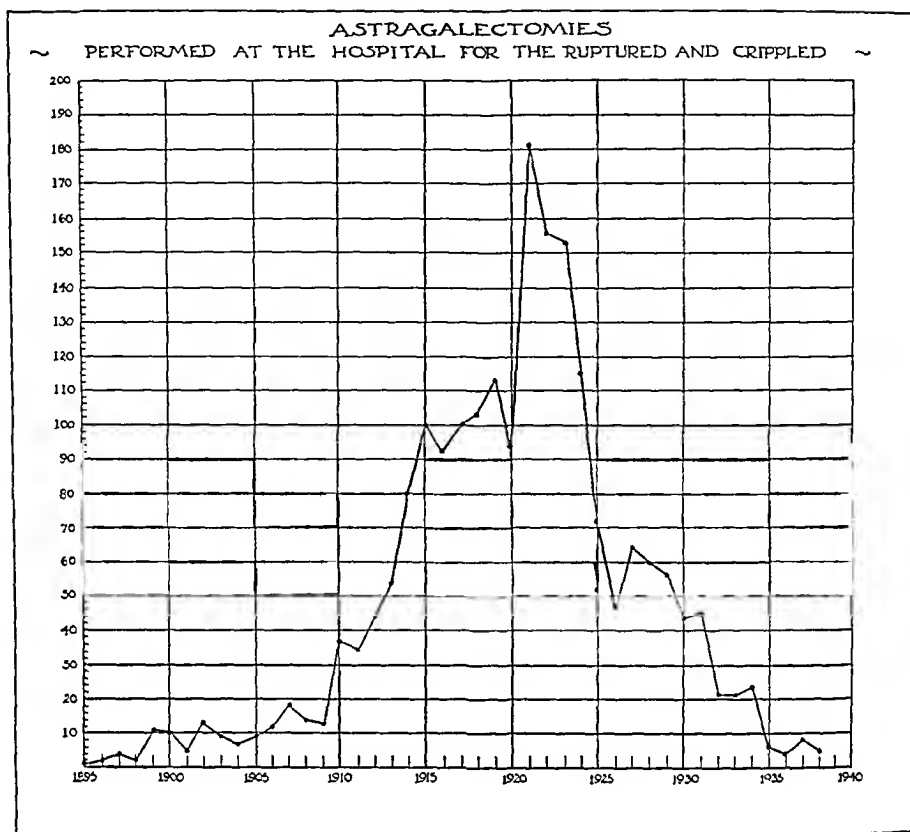


Fig. 1

Distribution per year of 2066 astragalectomies performed at the Hospital for the Ruptured and Crippled from 1895 to 1938 inclusive.

4. Limited ankle-joint motion, especially dorsiflexion;
5. Freedom from pain;
6. No external support;
7. Satisfactory appearance and no special shoe.

These criteria are more rigid than those of Hoke. Many orthopaedic surgeons seem to be satisfied with less, but an artificial foot fulfills these requirements, and certainly a satisfactory stabilization should produce a foot as good as an artificial one.

#### THE PROBLEM OF CALCANEUS DEFORMITY

Astragalectomy with posterior displacement of the foot was introduced by Whitman as a treatment for calcaneovalgus. In this condition the astragalus is perched upon the top of the os calcis, which is upright instead of horizontal. The entire body weight is thrown upon the tuberosity of the os calcis, and the forefoot serves no useful function.

The fact that calcaneus is probably the most difficult of any foot deformity to correct is shown by the large number of methods proposed for its treatment. It is unfortunate that the different ingenious operations which have been designed by Sir Robert Jones, Naughton Dunn, Hoke,

Putti, Brewster, Lambrinudi, Miller, and others cannot be described in detail. Although these corrective procedures can produce perfect cosmetic results, they rarely succeed in limiting dorsiflexion sufficiently to permit the patient to transfer the entire body weight to the ball of the foot, unless the ankle has been included among the arthrodesed joints or a successful Gallic tenodesis of the tendo achillis has been performed. Furthermore, arthrodesing operations and tenodeses are not uniformly successful in patients under the age of ten or twelve. Calcaneus is a disability as well as a deformity, and limitation of dorsiflexion with restoration of the "push off" is really more important from the patient's standpoint than the appearance of the foot or the alignment of the bones as shown in a roentgenogram. Panarthrodesis, including the ankle joint, is preferred to astragalectomy by some surgeons, but sufficient posterior displacement and solid fusion of all these joints are not easily accomplished, and the alignment must be perfect to ensure good function in an entirely rigid foot and ankle. Ankle fusion, especially in children, is difficult to obtain, and is likely to disturb growth at the lower tibial epiphysis, causing additional shortening or deformity.

#### ASTRAGALECTOMY

A successful astragalectomy corrects the deformity and reestablishes good function. It brings the leg down upon the foot, displaces the foot



FIG. 2-A

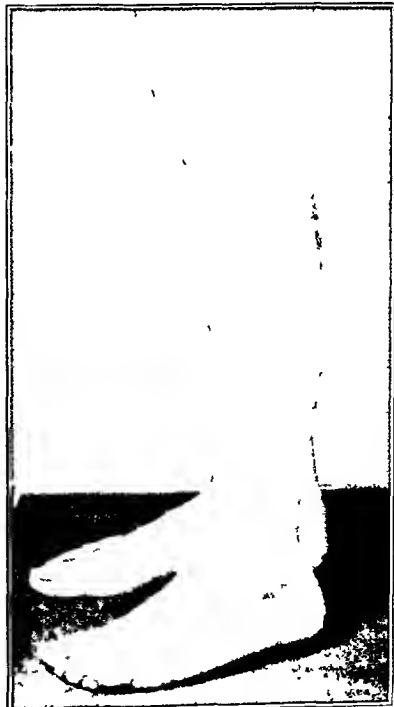


FIG. 2-B

Ideal position nine months after astragalectomy.



TABLE I  
Good Results

Case No.	Sex	Age at Operation (Years)	Deformity	Postoperative Period (Years)	Fused	Tibialis Anterior	Remarks
1	Female	4	Calcaneovalgus	19	—	0	Function good. Appearance fair.
2	Male	3	Flail	19	—	0	Wears brace for flail leg.
3	Female	8	Calcaneus	18	—	+	Muscles good except those of calf. Slight dorsal bunion.
4	Male	17	Equinovalgus (right)	16	—	0	Excellent. Foot looks normal.
5	Male	17	Flail (left)	16	—	0	Excellent. Wears brace for knee.
6	Male	7	Flail	16	+	0	Wears brace for flail knee.
7	Male	8	Flail	15	—	0	Excellent. Works as stevedore.
8	Female	3	Calcaneovalgus	12	—	0	Excellent. Runs rapidly.
9	Female	9	Flail	12	+	0	Knee fusion twelve years after operation.
10	Male	19	Flail	11	+	0	Two fragments present. No pain.
11	Female	7	Calcaneovalgus	11	—	+	Muscles good except those of calf. Slight varus.
12	Male	7	Calcaneovalgus	10	+	0	No fatigue. Shortening of three-quarters of an inch.
13	Male	6	Flail	10	—	0	Excellent.
14	Female	4	Equinovarus	10	+	0	Biceps transplantation two years after operation.
15	Male	13	Calcaneus	0	+	0	More equinus would be better.
16	Male	4	Calcaneovalgus	10	—	0	Wears brace for flail knee.
17	Male	5	Calcaneovalgus	9	+	0	Epiphysiodesis of opposite leg.
18	Female	11	Equinovalgus	9	+	0	Leg lengthening six years after operation.
19	Male	5	Flail (right)	9	—	0	Spina bifida.
20	Male	5	Flail (left)	9	—	0	Spina bifida.
21	Female	5	Flail	9	—	0	Loose fragments, but no pain.
22	Male	7	Flail	9	+	0	Biceps transplantation. Knee still weak.
23	Male	5	Flail	9	—	0	Abductor limp improved by equinus position of foot.
24	Male	13	Calcaneovalgus	9	+	+	Ingrowing toe nail.
25	Female	11	Flail	9	—	0	Normal appearance.
26	Female	20	Flail	8	—	0	Good though operation was done late.

	Female	7	Calcanicus	8	+	0	One and one-half inches of shortening before and after operation.
27	Female				+	0	Better than Hoke operation on opposite foot.
28	Male	10	Calcanicus ++	8	+	0	Muscle transplantation nine years before operation.
29	Male	17	Calcaneovalgus	8	-	0	Wears brace for flail knee.
30	Male	7	Calcaneovalgus	7	-	0	Excellent. Fusion prevents varus.
31	Male	9	Calcaneovalgus	7	+	+	"Push off" not satisfactory.
32	Male	8	Calcaneovalgus	7	-	Trace	Knee fusion one year before operation.
33	Female	18	Flail	7	+	0	Wears brace for flail leg.
34	Male	12	Flail	7	-	0	Supracondylar osteotomy seven years after operation.
35	Female	13	Flail	7	+	0	Developed progressive muscular dystrophy.
36	Male	5	Calcaneovalgus	7	-	0	Hoke operation at age of six had failed. Rotation osteotomy two years after operation.
37	Male	10	Calcaneovalgus	7	+	0	Knee fusion two years after operation.
38	Male	9	Calcaneovalgus	6	+	0	Rotation osteotomy two years after operation. Epiphysiodesis of opposite tibia six years after operation.
39	Male	7	Flail	6	+	0	Excellent. Foot appears normal.
40	Female	12	Flail	5	-	0	Marked external torsion. Epiphysiodesis of opposite femur and tibia.
41	Male	9	Calcancovalgus	5	-	0	Bone fragments present. No pain.
42	Male	11	Calcancovalgus	4	-	0	Excellent. Walks and runs well.
43	Male	6	Valgus	4	-	0	Rotation osteotomy one year after operation.
44	Male	4	Flail	4	-	0	Excellent.
45	Male	12	Flail	4	-	0	Tibialis anterior sectioned preoperatively.
46	Female	4	Calcancovarus	3	-	++	Panarthrodesis would probably have been better.
47	Female	20	Flail	3	+	0	Rotation osteotomy two years after operation.
48	Male	8	Calcanicus	2	-	0	Excellent. External torsion of 35 degrees.
49	Male	8	Calcaneovalgus	2	-	0	Tibialis anterior resected at operation.
50	Female	5	Calcancovalgus	2	-	++	Brace on opposite leg.
51	Female	8	Calcancovalgus	2	-	0	Excellent.
52	Female	16	Flail	1	-	0	External torsion of 30 degrees.
53	Male	9	Flail	1	-	0	External torsion of 35 degrees.
54	Male	9	Flail	1	-	0	



FIG. 3-A



FIG. 3-B

Range of motion after astragalectomy.

backward, and produces good contact between the foot and the ground. It eliminates lateral instability and brings the lower end of the tibia over the center of the weight-bearing area. It limits motion between the leg and foot, especially in dorsiflexion. It can be done between the ages of five and ten, when arthrodesing operations are not advisable. For these reasons, the results of astragalectomy in calcaneus and calcaneovalgus are usually satisfactory, and it is probably still the best method of correcting these deformities.

Although astragalectomy is also satisfactory in the treatment of flail feet, it is apt to fail if there is any tendency toward equinus or varus. For twenty years after its introduction the operation gained rapidly in popularity, and, because of the gratifying results, it was tried for all kinds

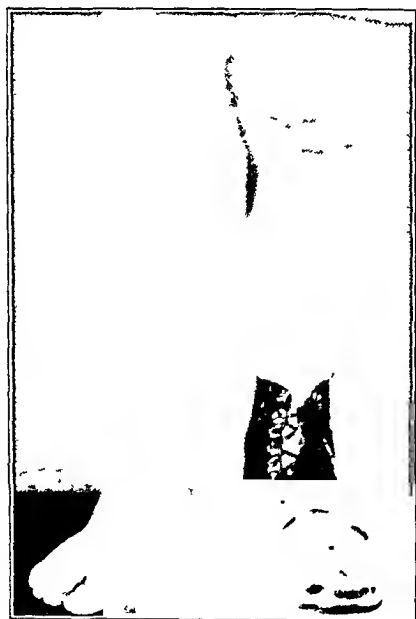


FIG. 4  
Case 69



FIG. 5  
Case 61

Moderate and marked external torsion of tibia. Foot aligned with malleoli and not with patella.

## FAIR RESULTS

Case No.	Sex	Age at Operation (Years)	Deformity	Post-operative Period (Years)	Fused	Tibialis Anterior	Cause of Partial Failure			Remarks
							Slight Varus	Poor Push Off	Slight Pain	
55	Female	12	Calcaneus	12	-	++	-	+	-	Tibialis anterior strong.
56	Female	3	Flail	9	-	0	+	-	-	Marked external torsion. Too young at operation.
57	Female	19	Flail	9	-	0	-	-	+	Pain began five years after operation.
58	Female	16	Calcaneus	8	-	++	-	-	+	Also has pain in opposite foot after panarthrodesis.
59	Female	9	Flail	8	+	0	+	-	-	Lateral wedge seven years after operation.
60	Female	6	Flail	7	-	0	+	+	-	Insufficient posterior displacement.
61	Male	10	Calcaneus ++	6	-	Trace	-	+	-	Insufficient posterior displacement.
62	Male	9	Flail	6	-	0	+	-	-	Hoke operation advised and would have been better.
63	Male	16	Equinovalgus	6	-	0	-	+	+	Tibial muscles transplanted ten years before operation.
64	Female	6	Calcaneus	5	+	+	-	+	-	Dorsiflexors strong.
65	Female	8	Equinovarus	5	+	0	+	-	+	Too much equinus.
66	Male	4	Calcaneovalgus	5	-	?	-	+	-	Young at time of astragalectomy.
67	Female	9	Calcaneovalgus	4	+	++	+	+	-	Tibialis anterior still strong.
68	Male	6	Calcaneovalgus	3	-	+	+	+	-	30 degrees of external torsion.
69	Male	7	Varus	3	-	0	+	-	-	Tibialis posterior present.
70	Female	8	Equinovarus	1	-	0	+	-	-	Tendo achillis fair. Varus may increase.
71	Male	9	Flail	1	-	0	+	-	-	Marked external torsion.
72	Male	5	Flail	1	-	Trace	+	-	-	Tibial epiphysis injured.

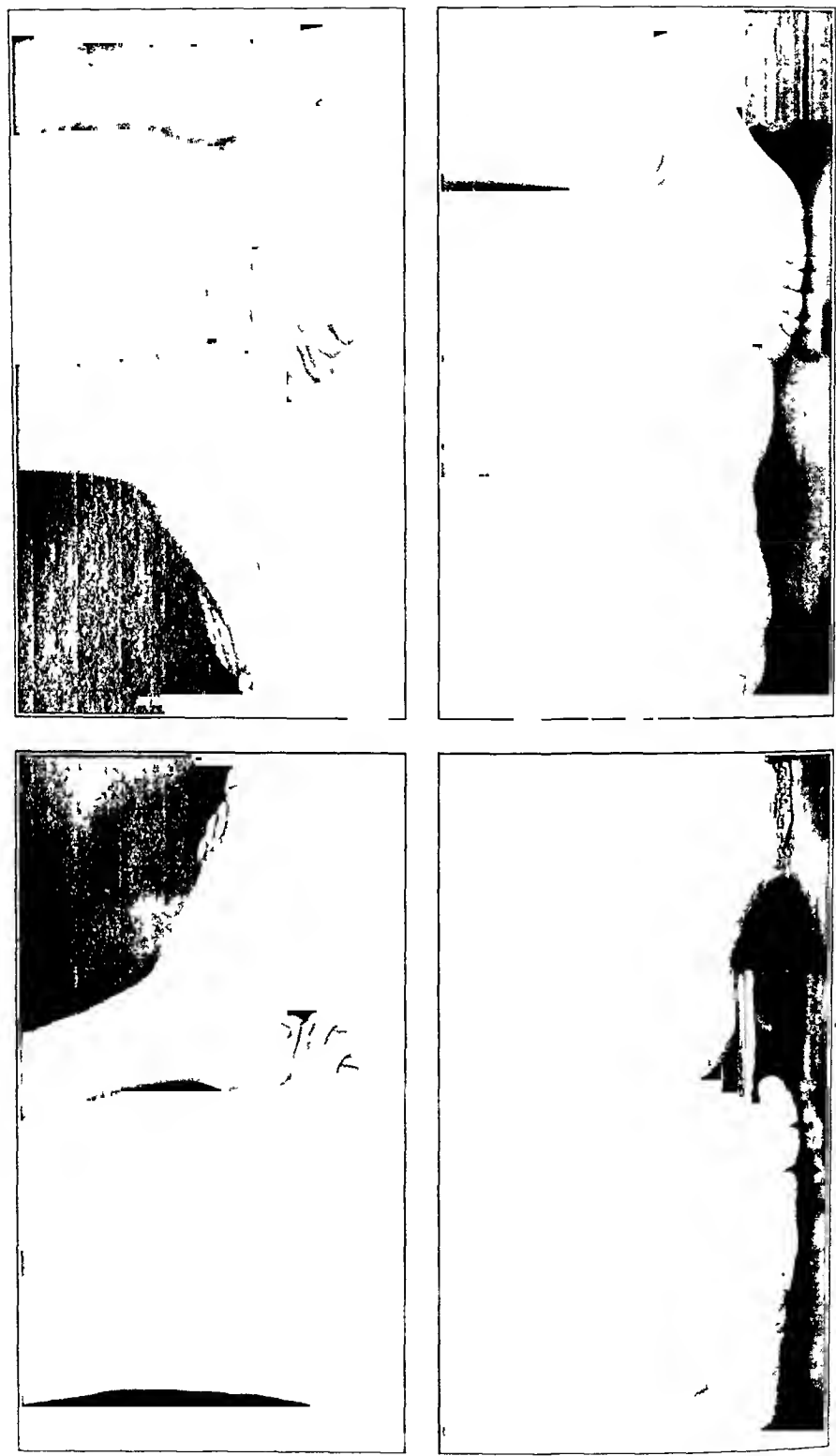


Fig. 6-A  
Case 52. Correction of calcaneus.

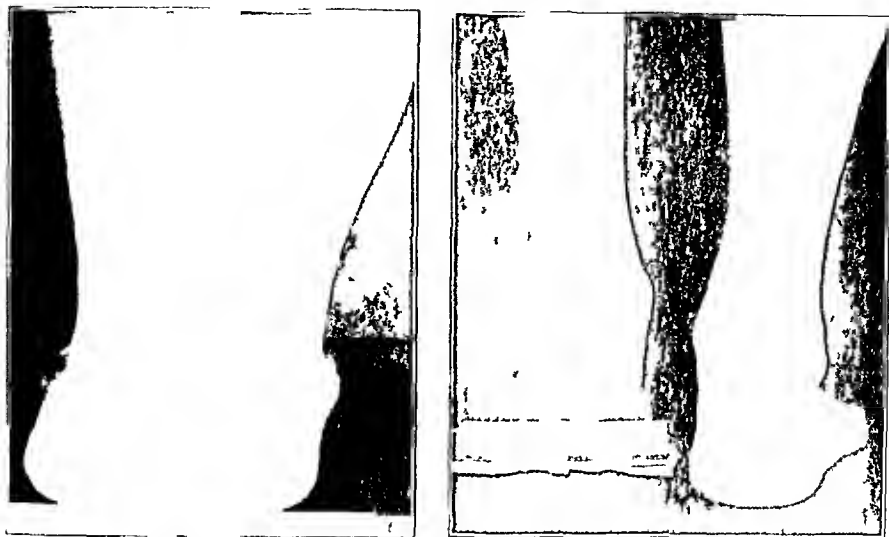


FIG 6-B

Case 52. Correction of valgus

of deformity and instability. Naturally the number of failures increased, and it is unfortunate that overenthusiasm led to frequent misapplication. Much of the disrepute into which the operation has fallen has been due to the fact that definite contra-indications have not been recognized. The stabilizing operations developed by Davis, Dunn, Ryerson, Hoke, and others<sup>3</sup> have largely and rightly supplanted astragalectomy in the treatment of ordinary equinus, varus, and valgus deformities.

It is hoped that this study will show that there are certain definite contra-indications to astragalectomy and that its real usefulness is still in the treatment of that condition for which it was originally designed,—namely, paralytic calcaneoval-

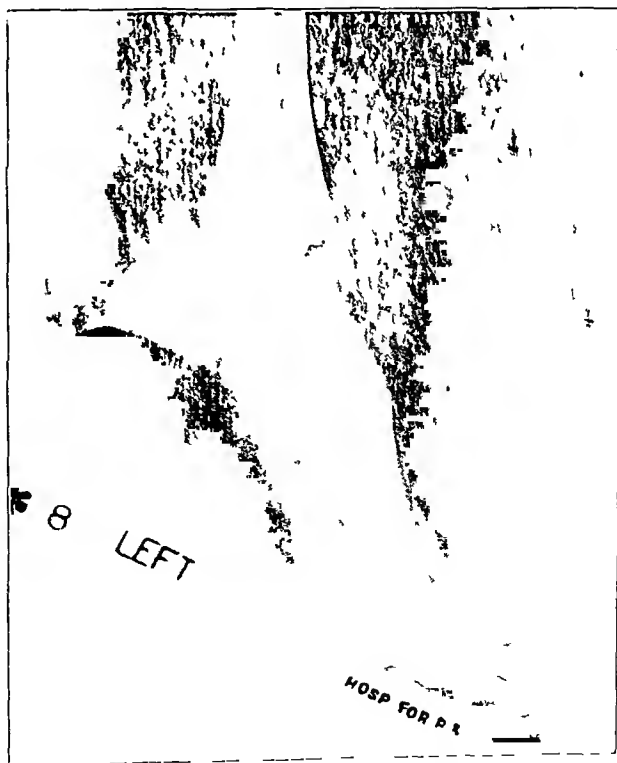


FIG 6-C

Case 52 Roentgenogram showing posterior displacement.

TABLE III  
Poor Results

Case No.	Sex	Age at Operation (Years)	Deformity	Post-operative Period (Years)	Fused	Tibialis Anterior	Cause of Failure			Reoperations	Remarks
							Varus	Cal-caneus	Pain		
73	Female	8	Valgus	24	-	0	-	-	++	0	Loose fragments. Pain began fifteen years after operation.
74	Male	5	Calcaneovalgus	18	+	++	++	+	-	3	Anterior block failed. Now fused and result good.
75	Female	5	Varus	17	-	+	+	-	-	1	Lateral wedge three years after operation. Result now fair.
76	Female	10	Equinovarus	17	-	?	+	-	++	1	Lateral wedge six years after operation. Pain persists.
77	Female	6	Calcaneus	17	-	+	++	-	-	1	Anterior block four years after operation failed.
78	Male	3	Equinovalgus	14	-	0	-	+	+	1	Tendon transplantation ten years after operation. Pain began fourteen years after operation.
79	Female	8	Flail	13	-	0	-	-	+	1	Excision of fragments twelve years after operation. Result now good.
80	Male	3	Calcaneovalgus	13	+	++	-	+	-	1	Reconstruction two years after operation. Fused. Result now good.
81	Male	4	Equinovalgus	13	+	0	-	-	-	1	Tenotomy of tendo achillis five years after operation for equinus. Result now good.
82	Female	5	Calcaneovalgus (?)	12	-	?	-	+	-	2	Operation for equinovarus five years after operation. Fusion nine years after operation. Result now fair.
83	Male	4	Calcaneovalgus	12	-	0	-	++	-	2	Pain began seven years after operation. Excision of fragments. Fusion. Result now fair.

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84	Female	6	Equinovarus ++	11	+	++	+++	-	-	3	Varus recurred three times. Section of tibialis anterior and fusion. Result now good.
85	Female	3	Calcaneus ++	10	+	++	+	++	-	4	Calcaneus and varus recurred until fusion six years after operation. Result now good.
86	Female	3	Equinovarus	10	-	?	++	-	-	2	Two stretchings for varus. Operation advised. Result still poor.
87	Female	6	Calcaneus	8	+	+	-	++	+	2	Result good until leg lengthening two years after operation. Now fair.
88	Female	7	Calcaneus	7	-	++	++	-	-	0	Reoperation refused. Result still poor.
89	Female	21	Flail	6	-	0	-	-	-	-	Operation useless. Still uses crutches.
90	Male	19	Equinovarus	6	-	0	-	-	++	2	Tenotomy of tendo achillis two years after operation. Loose fragments.
91	Female	3	Calcaneus	5	-	++	-	++	-	0	To have reconstruction or fusion later.
92	Male	4	Calcaneovarus	5	-	++	++	-	-	2	Reconstruction. Section of tibialis anterior and tibialis posterior. Result now good.
93	Male	2	Calcaneovarus	5	-	++	++	-	-	2	Reconstruction and transplantation of tibialis anterior. Result now good.
94	Female	9	Calcaneus	5	-	?	-	++	+	0	Not displaced back enough.
95	Female	19	Equinovarus	4	-	0	Slight	-	++	0	Varus slight. Age at operation cause of pain (-).
96	Female	26	Flail (left)	4	-	0	-	-	++	0	Age at operation cause of pain (?).
97	Female	26	Equinovarus (right)	4	-	0	-	-	++	0	Age at operation cause of pain (?).
98	Female	4	Calcaneovarus	3	-	++	++	++	-	0	Tenotomy of tibialis anterior refused.
99	Female	19	Equinovalgus	3	-	0	-	-	++	0	Loose fragments present. Age at operation cause of pain (?).
100	Male	5	Calcaneovarus	1	-	++	++	+	-	0	Extensor hallucis longus and tibialis anterior cause recurring calcaneovarus.



gus. Transplantation of all available muscles into the os calcis does not reestablish a good "push off". Radical treatment is required to restore propulsive power and to compensate for the loss of one of the two strongest muscles in the body.

#### OPERATIVE TECHNIQUE

The operative technique will not be described in detail. There are, however, several essential points which may determine its success or failure. The actual removal of the astragalus is only the first step. The long curved lateral incision of Kocher gives ample exposure, so that the bone can be removed in one piece, leaving no fragments behind. The ligaments are stripped off both malleoli, so that the foot can be easily displaced backward. The lateral malleolus fits into a slot opposite the calcaneocuboid joint, while the medial malleolus lies just above and behind the navicular. In order to accomplish this, the foot must be externally rotated beneath the leg, often as much as 30 or 40 degrees. The foot must *not* be aligned with the patella. The new axis of motion will run between the two malleoli, and the long axis of the foot must be at a right angle to this. This principle, emphasized by Chambers in the treatment of varus deformities, applies to all forms of foot stabilization, and failure to observe it is a common cause for poor function and uneven weight-bearing in a foot that appears perfect. The first plaster, which extends above the knee, is applied with the foot held far backward in marked equinus and valgus. Any attempt to correct external rotation will only produce a varus deformity. If the patient cannot compensate for the external torsion of the tibia by internal rotation of the entire extremity, an osteotomy can be done through the tibia at a later date. This was necessary in only four cases in the present series.



FIG. 7-A



FIG. 7-B

Case 12. Fused in moderate equinus. Function excellent.

## AFTER-CARE

The plaster is changed at the end of two or three weeks, and the position of the foot is carefully checked. A snugly fitting cast, extending up to the knee, is applied with the foot still in equinus, slight valgus, and as much external rotation as there is torsion of the tibia. A few weeks later the heel of the plaster is built up with cork, and the patient is allowed to bear weight. The cast is removed at the end of twelve weeks. The heel of the shoe is raised from one inch to one and one-half inches, and an outer wedge is applied if there has been or is the slightest tendency toward varus. The patient is not allowed to



FIG. 7-C



FIG. 7-D

walk barefooted for at least a year after the operation. Limitation of dorsiflexion at 100 degrees in a boy and at 110 degrees in a girl is considered ideal, but a fixed equinus of 30 or even 40 degrees gives a strong foot and an excellent gait. A lift under the heel of the shoe will distribute



FIG. 7-E

walk barefooted for at least a year after the operation. Limitation of dorsiflexion at 100 degrees in a boy and at 110 degrees in a girl is considered ideal, but a fixed equinus of 30 or even 40 degrees gives a strong foot and an excellent gait. A lift under the heel of the shoe will distribute

TABLE III  
POOR RESULTS

Case No.	Sex	Age at Operation (Years)	Deformity	Post-operative Period (Years)	Fused	Tibialis Anterior	Cause of Failure			Reoperations	Remarks
							Varus	Cal-caneus	Pain		
73	Female	8	Valgus	24	-	0	-	-	++	0	Loose fragments. Pain began fifteen years after operation.
74	Male	5	Calcaneovalgus	18	+	++	++	+	-	3	Anterior block failed. Now fused and result good.
75	Female	5	Varus	17	-	+	+	-	-	1	Lateral wedge three years after operation. Result now fair.
76	Female	10	Equinovarus	17	-	?	+	-	++	1	Lateral wedge six years after operation. Pain persists.
77	Female	6	Calcaneus	17	-	+	+	++	-	1	Anterior block four years after operation failed.
78	Male	3	Equinovalgus	14	-	0	-	-	+	1	Tendon transplantation ten years after operation. Pain began fourteen years after operation.
79	Female	8	Flail	13	-	0	-	-	+	1	Excision of fragments twelve years after operation. Result now good.
80	Male	3	Calcaneovalgus	13	+	++	-	++	-	1	Reconstruction two years after operation. Fused. Result now good.
81	Male	4	Equinovalgus	13	+	0	-	-	-	1	Tenotomy of tendo achillis five years after operation for equinus. Result now good.
82	Female	5	Calcaneovalgus (?)	12	-	?	+	-	+	2	Operation for equinovarus five years after operation. Fusion nine years after operation. Result now fair.
83	Male	4	Calcaneovalgus	12	-	0	-	-	++	2	Pain began seven years after operation. Exclusion of fragments. Fusion. Result fair.

84	Female	6	Equinovarus ++	11	+	++	+++	-	-	3	Varus recurred three times. Section of tibialis anterior and fusion. Result now good.
85	Female	3	Calcaneus ++	10	+	++	+	++	-	4	Calcaneus and varus recurred until fusion six years after operation. Result now good.
86	Female	3	Equinovarus	10	-	?	++	-	-	2	Two stretchings for varus. Operation advised. Result still poor.
87	Female	6	Calcaneus	8	+	+	-	++	+	2	Result good until leg lengthening two years after operation. Now fair.
88	Female	7	Calcaneus	7	-	++	++	-	-	0	Reoperation refused. Result still poor.
89	Female	21	Flail	6	-	0	-	-	-	-	Operation useless. Still uses crutches.
90	Male	19	Equinovarus	6	-	0	-	-	++	2	Tenotomy of tendo achillis two years after operation. Loose fragments.
91	Female	3	Calcaneus	5	-	++	-	++	-	0	To have reconstruction or fusion later.
92	Male	4	Calcaneovarus	5	-	++	++	-	-	2	Reconstruction. Section of tibialis anterior and tibialis posterior. Result now good.
93	Male	2	Calcaneovarus	5	-	++	++	-	-	2	Reconstruction and transplantation of tibialis anterior. Result now good.
94	Female	9	Calcaneus	5	-	?	-	++	+	0	Not displaced back enough.
95	Female	19	Equinovarus	4	-	0	Slight	-	++	0	Varus slight. Age at operation cause of pain (?).
96	Female	26	Flail (left)	4	-	0	-	-	++	0	Age at operation cause of pain (?).
97	Female	26	Equinovarus (right)	4	-	0	-	-	++	0	Age at operation cause of pain (?).
98	Female	4	Calcaneovarus	3	-	++	++	++	-	0	Tenotomy of tibialis anterior refused.
99	Female	19	Equinovalgus	3	-	0	-	-	++	0	Loose fragments present. Age at operation cause of pain (?).
100	Male	5	Calcaneovarus	1	-	++	++	+	-	0	Extensor hallucis longus and tibialis anterior cause recurring calcaneovarus.

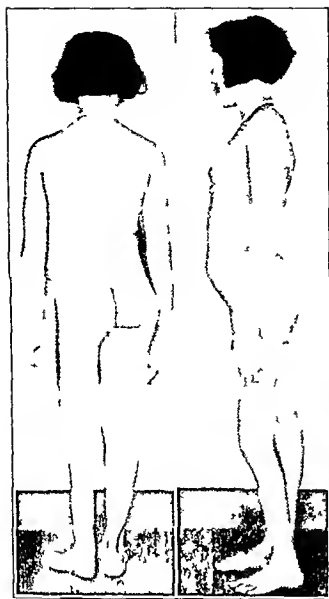


FIG. 8-A

Case 60. Cosmetically good, functionally poor. Insufficient posterior displacement. Small remaining fragment of astragalus still growing



FIG. 8-B

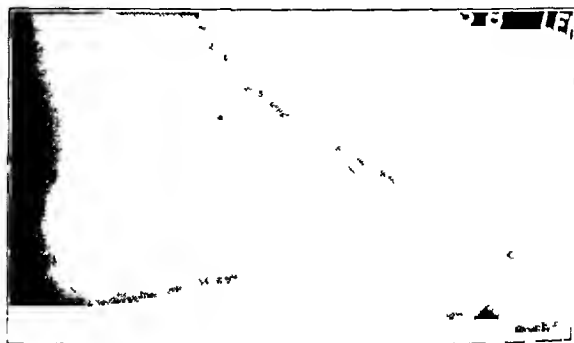


FIG. 8-C

the body weight to the entire foot, and a moderate equinus deformity helps greatly to compensate for the shortening of the paralyzed extremity, which is often considerable. These patients do not complain of the fact that they cannot bring the heel to the ground when walking without shoes.

#### ANALYSIS OF RESULTS

Careful examination of 100 patients has furnished more useful information than the analysis of more than 2,000 case records. Special efforts were made to evaluate results as long as possible after operation, but all available paralytic cases have been included with the exception of five in which the operation was performed during 1938. (See Tables I, II, and III.) In those cases with no deformity, good weight distribution, no pain, and a good "push off" the results were considered good. In those cases with slight deformity, slight pain, or poor "push off" the results were classified as fair. In any case in which recurrence of deformity or pain was noted or subsequent operative treatment was required, the result was rated as poor. The statistics are perhaps a little unfair, as any patient with a poor result who returned for reoperation has been included, while many patients with good results have been lost. Although the present status of this series is sixty-four good results, nineteen fair, and seventeen poor, all cases requiring reoperation were classed as poor for purposes of analysis, thus changing the figures to fifty-four good results, eighteen fair, and twenty-eight poor.

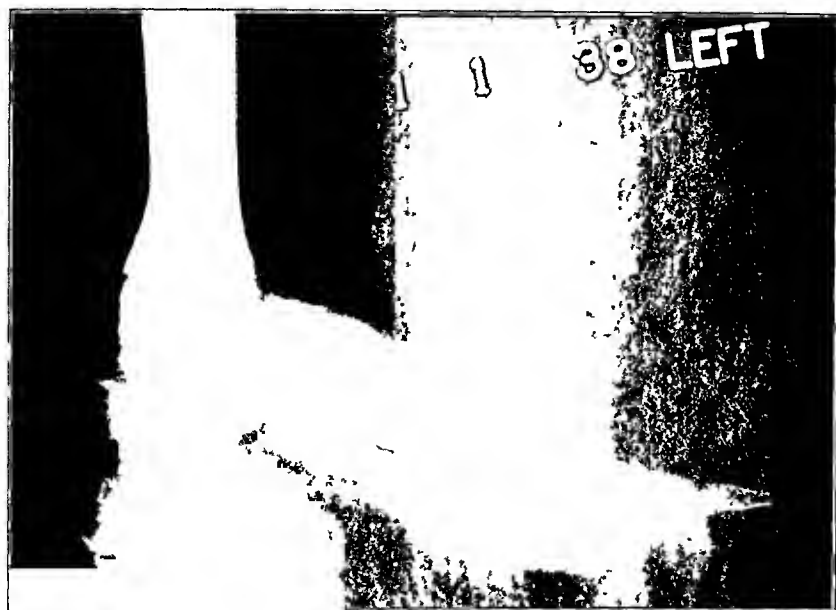


FIG 9-A



FIG. 9-B



FIG. 9-C

Case 91. Recurrence of calcaneus due to strong tibialis anterior.

Eleven of the good results are really excellent and approximate the normal foot in function. Fusion of the fibula to the os calcis occurred in twenty-nine cases, but did not detract from the result unless there was definite deformity. In fact, some of the patients with the best functional results had no motion between the os calcis and the leg.

The causes of failure or partial failure, as well as could be determined, were as follows:

1. Strong tibialis anterior muscle;
2. Preoperative equinus or varus deformity;
3. Good power in the tendo achillis;
4. Patient too young or too old (under five or over fifteen);
5. Errors in operative technique.

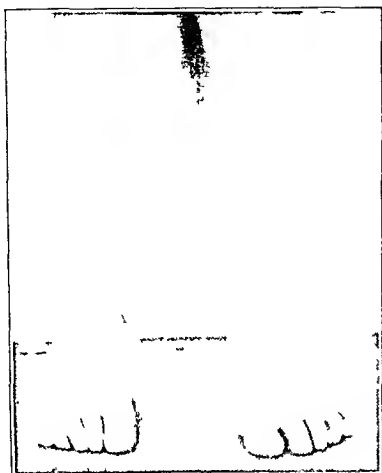


FIG 10-A



FIG 10-B

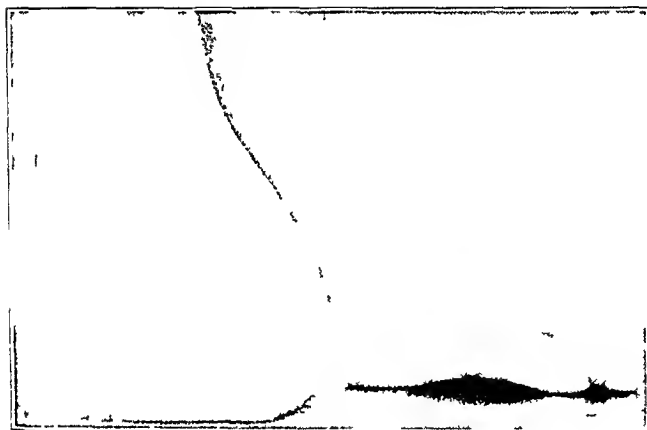


FIG. 10-C

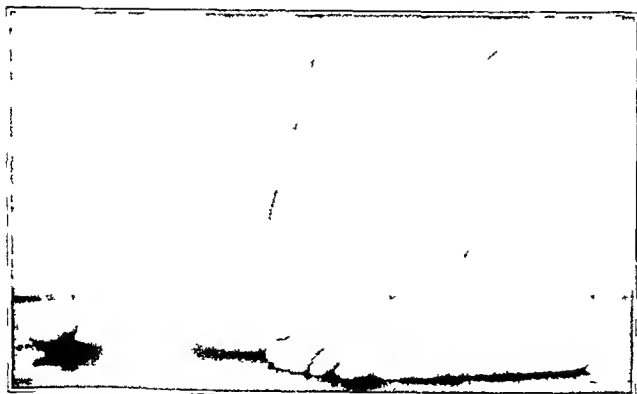


FIG. 10-D

Case 100 One year after operation. Recurrence of varus due to preoperative calcaneovarvarus deformity and a strong tibialis anterior.

By far the most common reason for recurrence of deformity is muscle imbalance. Even an arthrodesing operation does not prevent a foot from gradually yielding to unbalanced muscle pull, and certainly one would not expect a foot upon which an astragalectomy had been done to be any more resistant. Any power remaining in the tibialis anterior or posterior or in the tendo achillis will almost surely produce a varus or equinus deformity. Even without demonstrable

muscle power, these deformities tend to recur. In analyzing Sever's report of 1920, in which he reviewed 217 astragalectomies, it was found that of 188 cases in which the preoperative deformity was described, this

TABLE IV  
CORRELATION OF RESULTS WITH AGE AT OPERATION

Age at Operation	Results			
	Good	Fair	Poor	Total
Under five years . . . . .	7	2	10	19
Between five and ten years . . . . .	28	11	11	50
Between ten and fifteen years . . . . .	11	2	1	14
Over fifteen years . . . . .	8	3	6	17
Total . . . . .	54	18	28	100

TABLE V  
ASTRAGALECTOMY RESULTS ANALYZED ON THE BASIS OF PREOPERATIVE DEFORMITY

Preoperative Deformity	Results			
	Good	Fair	Poor	Total
Calcaneus and Calcaneovalgus . . . . .	24	7	10	41
Flail . . . . .	25	7	3	35
Calcaneovarus . . . . .	1*	0	4	5
Equinovarus and varus . . . . .	1	3	7	11
Miscellaneous . . . . .	3	1	4	8
Total . . . . .	54	18	28	100

\* Tibialis anterior sectioned.

operation definitely should not have been performed in 108. Of the nine cases with unsatisfactory results in a series of sixty reported by Armitage Whitman in 1920 the operation was contra-indicated in five, because of a preoperative equinus or varus deformity. In the present series many of the patients would probably have done as well or better with some arthrodesing operation, and in approximately 50 per cent. of the cases astragalectomy was definitely contra-indicated.

In twenty-eight cases in this series the results are rated as poor. There was postoperative varus in thirteen instances, recurrent calcaneus in nine, and pain in thirteen. Of these failures, only six could be attributed to faulty operative technique. In one case the foot had not been displaced backward, and in five cases fragments of the astragalus remained. Ten patients operated upon under the age of five had recurrent deformity. Of the six who were over fifteen at the time of operation, five complained of persistent pain; the other patient (Case 89) never bore





Fig. 11-D

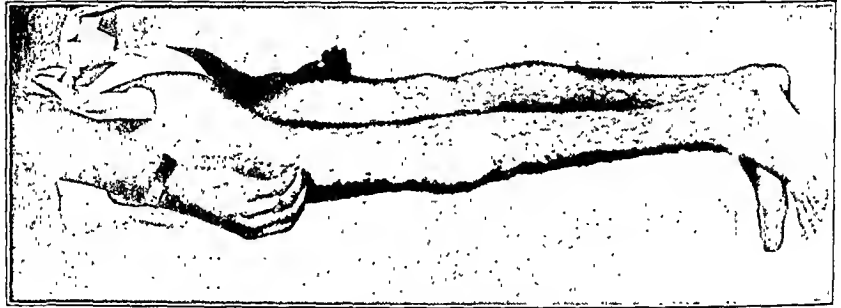


Fig. 11-C

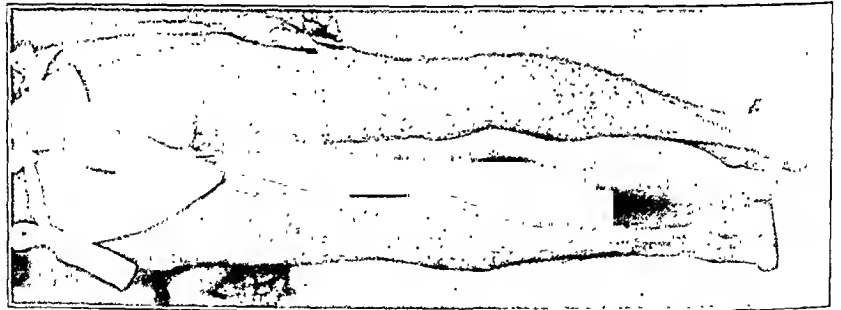


Fig. 11-B



Fig. 11-A

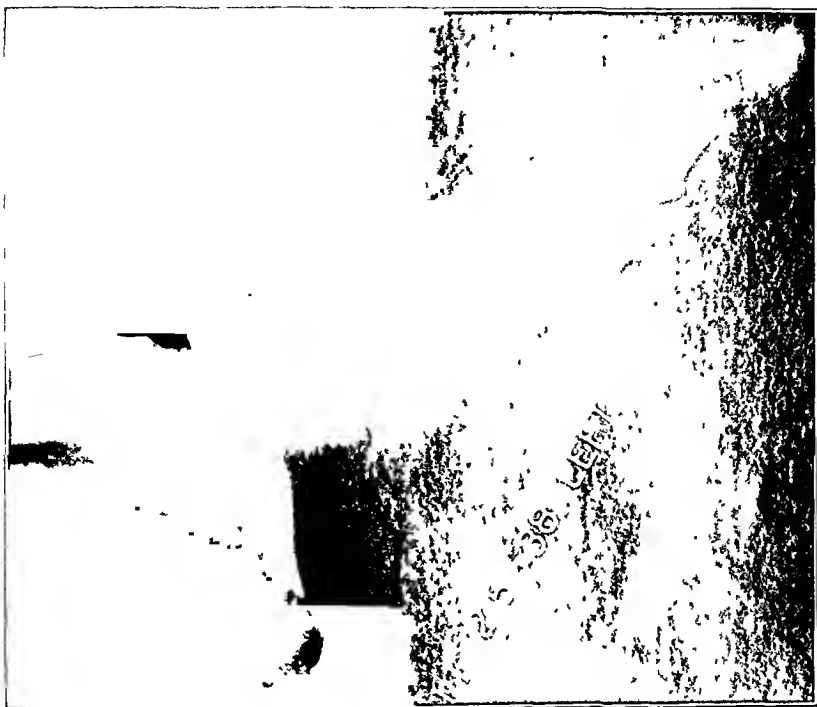


FIG. 11-G

No power below knee. Excellent function. No limp.

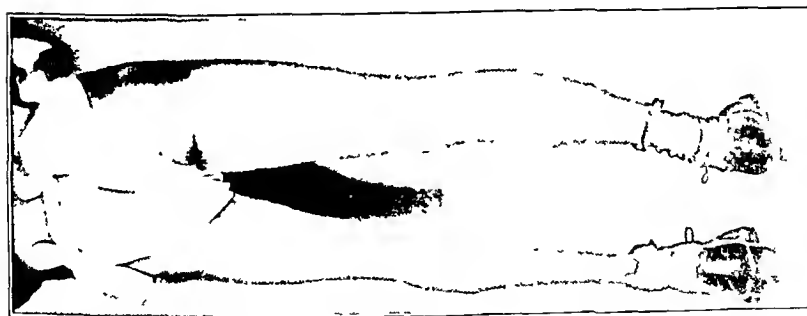


FIG. 11-F

Astragalectomy at age of twenty-three. Works as stevedore.



FIG. 11-E

Patient at age of twenty-three. Works as stevedore.

weight on the leg either before or after operation. In these sixteen, astragalectomy was contra-indicated because of age (Table IV). In nine cases there was preoperative equinus, and in eleven, varus deformity. The tibialis anterior was strong in thirteen. Of these cases, the varus deformity recurred in ten and calcaneus in the other three. Of the seventy-two cases in which good and fair results were obtained, an active tibialis anterior was present in only eleven. In four of these, fusion of the fibula to the os calcis has prevented gross deformity. The others all have a definite tendency toward varus or calcaneus except two in which the tendon of the tibialis anterior was sectioned. Table V shows the results analyzed on the basis of preoperative deformity.

Disregarding twenty-nine subsequent operations which were done for reasons unrelated to astragalectomy, there were thirty-one reoperations upon seventeen patients for the correction of deformity or the relief of pain: twelve of these were reconstructions; four, lateral wedges; three, excisions of bone fragments; four, fusions; and eight, miscellaneous. Some of the seventeen patients in whose cases the results are now classified as poor may yet be improved by operation.

#### CONCLUSIONS

1. Astragalectomy can be used to stabilize a flail foot and is an effective method of correcting calcaneus deformity and restoring a good "push off".

2. Fusion between the foot and the leg does not detract from the result if the position is satisfactory.

3. If astragalectomy is done under the age of five, the deformity is apt to recur.

4. If astragalectomy is done over the age of fifteen, pain is a frequent complaint.

5. Preoperative equinus or varus deformity and a strong tibialis anterior are contra-indications to this procedure.

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## PRIMARY ANTERIOR CONGENITAL DISLOCATION OF THE HIP \*

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In spite of extensive investigative work on the part of many orthopaedic clinics, in spite of advances in regard to treatment during the past few years, and in spite of adequate trial of the many recommended procedures, unsatisfactory results are still encountered in patients with congenital dislocation of the hip. We feel that at least a part of these unsatisfactory results can be adequately explained on the basis of a true primary anterior type of dislocation.

Three distinct types of congenital dislocation can be clearly recognized and differentiated. The first of these is the classic posterior dislocation, which gives us our most clear-cut picture of the condition as it is commonly known. The second type consists merely of an upward subluxation of the femoral head as the result of an inadequate superior rim of the acetabulum. The third type of dislocation is that which exists in a true anterior position with the femoral head pointing directly forward, resting just behind and below the anterior superior spine. The advantage of an anterior dislocation over a posterior has long been recognized, and a transposition from the posterior to the anterior is one of the many surgical procedures that has been advised and used in the treatment of this condition. The existence of a true primary anterior dislocation, however, which differs distinctly in its clinical picture from the posterior type, and which differs also in its reaction to the usual methods of therapy, has never been adequately stressed. Ryerson described the clinical characteristics of such a case in 1907 and gave credit to Ridlon, Phelps, Willard, and Taylor for having reported similar cases previously. Turner described the characteristics of two cases of this type in his thesis for the American Orthopaedic Association and stressed the stability of these hips as compared with the posterior dislocations. He stated that these facts were not original with him, but were pointed out to him by Lorenz and Sir Robert Jones many years ago.

We believe that anterior dislocation of the hip exists as a true clinical entity, and our attention was first called to this condition when we noticed the marked frequency with which dislocations recurred in those patients whose hips were in an anterior position when first seen. At the same time it was noticed in this particular type of case that it was far more difficult to obtain a satisfactory reduction originally. In classifying the type of dislocation which is present in any given case, we have chosen arbitrarily

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 17, 1939.

the line of weight-bearing—that is, the line through which the center of gravity passes—for differentiating the anterior from the posterior type, rather than a true anatomical relationship of the femoral head to any given point on the pelvis itself. It is the relationship of the femoral head to this line that determines the clinical picture which these patients present.

#### CLINICAL FINDINGS

We have now seen ten cases of primary anterior dislocation of the hip, in all but two of which the condition has been unilateral. In one of the bilateral cases, the dislocation was primary anterior in type on both sides. In the second, however, anterior dislocation was present on one side and a posterior dislocation was present on the other. All of these cases have presented clinical findings which are distinct and sufficient to establish definitely the type of dislocation which is present. These clinical findings are as follows:

1. In contrast to the marked increase in the lumbar lordosis as seen in the posterior dislocations, the lumbar spine in these individuals is usually absolutely straight, frequently without even the normal amount of lumbar curve being seen. This is due to the fact that the abnormal thrust in an anterior dislocation is in front of the normal line of weight-bearing, thereby rolling the pelvis back and flattening the lumbar spine.

2. The buttock in a posterior dislocation is extremely prominent, as the result of the bulge of the trochanter in its upper portion. In contrast to this picture, in the anterior dislocation the buttock is flatter than normal.

3. The shortening in these individuals is usually not as great as that seen in patients with posterior dislocations. It is rare to see shortening of more than three-fourths of an inch in unilateral anterior dislocation in children under six years of age. As a result, the Trendelenburg sign is usually not as marked and the limp not as obvious in the young individuals.

4. In a posterior dislocation we frequently find a fossa anteriorly in the upper portion of the femoral triangle and some increased width of the perineum on this side. These are not present in the anterior dislocation; instead, a bulge is frequently seen just below the anterior superior spine, which is caused by the position of the femoral head. The head can often be outlined visually.

5. The femoral head can always be felt pointing anteriorly in these individuals, and the greater trochanter lies almost directly behind the head itself.

6. Lateral roentgenograms of the pelvis are not always satisfactory, but we have been successful in obtaining a few which show the definite anterior position of the femoral head in this particular type of case. The most satisfactory roentgenograms have been obtained by having the patient lie on the affected side with the roentgen-ray tube placed directly over the flank and tilted, so that the rays pass from above downward at an

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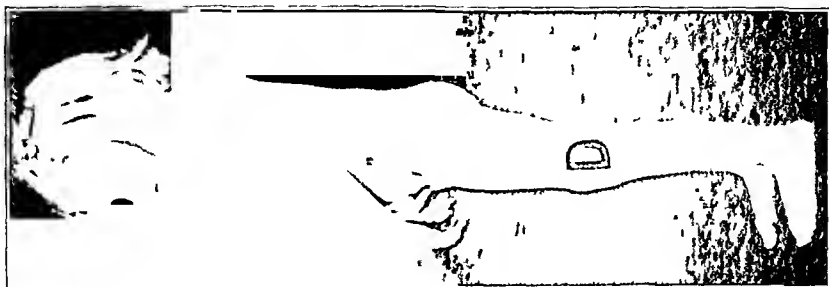


Fig 1-D

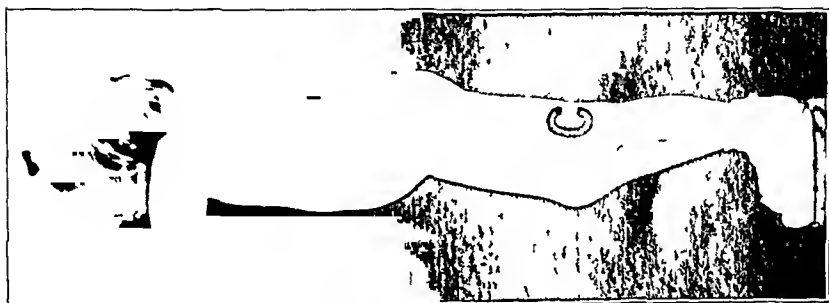


Fig 1-C

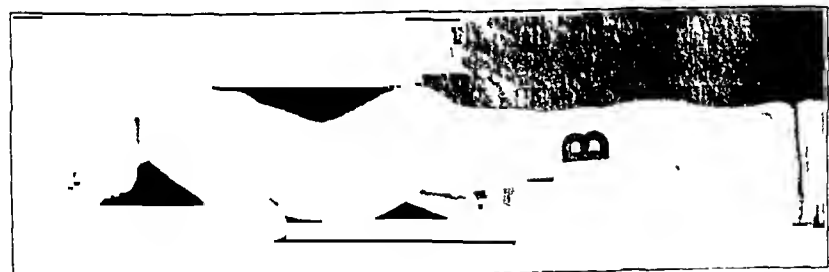


Fig 1-B

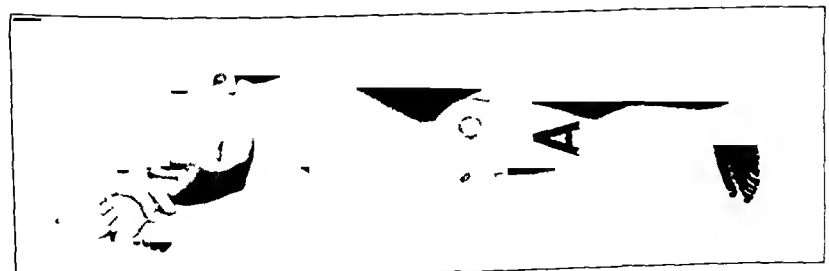


Fig 1-A

Lateral photographs showing the status of the lumbar spine in the various types of dislocation  
 Fig. 1-A: Bilateral posterior dislocation with extreme degree of lumbar lordosis  
 Fig. 1-B: Unilateral posterior dislocation showing moderate increase in lumbar curve.  
 Fig. 1-C: Unilateral upward subluxation with relatively normal lumbar curve  
 Fig. 1-D: Unilateral anterior dislocation with perfectly flat lumbar spine and complete absence even of the normal amount of lumbar curve



angle of about 25 degrees. This places the involved hip uppermost on the film and removes the overlying structures as much as possible.

7. A clinical trial, consisting of some form of closed reduction, has invariably been followed by recurrent anterior subluxation.

#### TREATMENT

The procedure which is used in the treatment of this particular type of dislocation has been determined entirely by the trial-and-error method

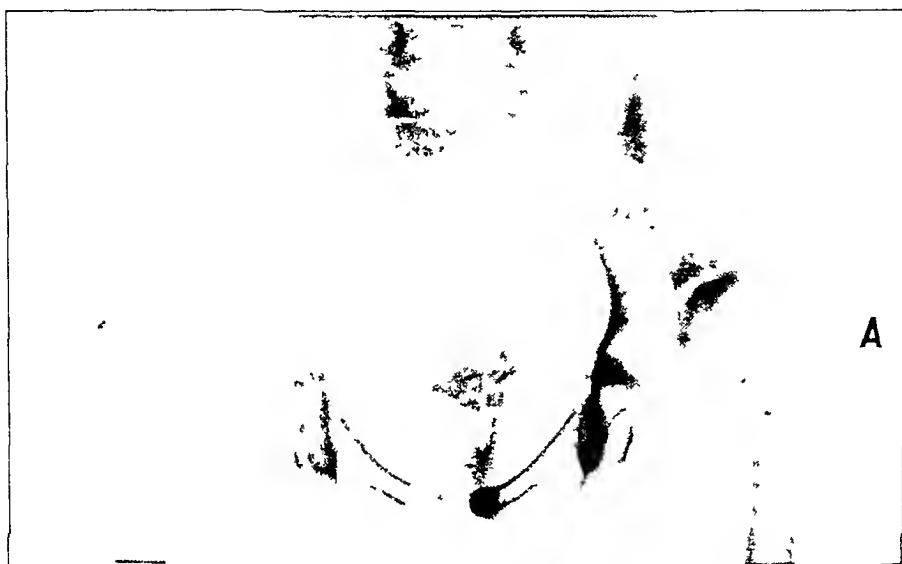


FIG. 2-A  
Bilateral posterior dislocation (See Fig 1-A )



FIG. 2-B  
Unilateral posterior dislocation. (See Fig. 1-B.)

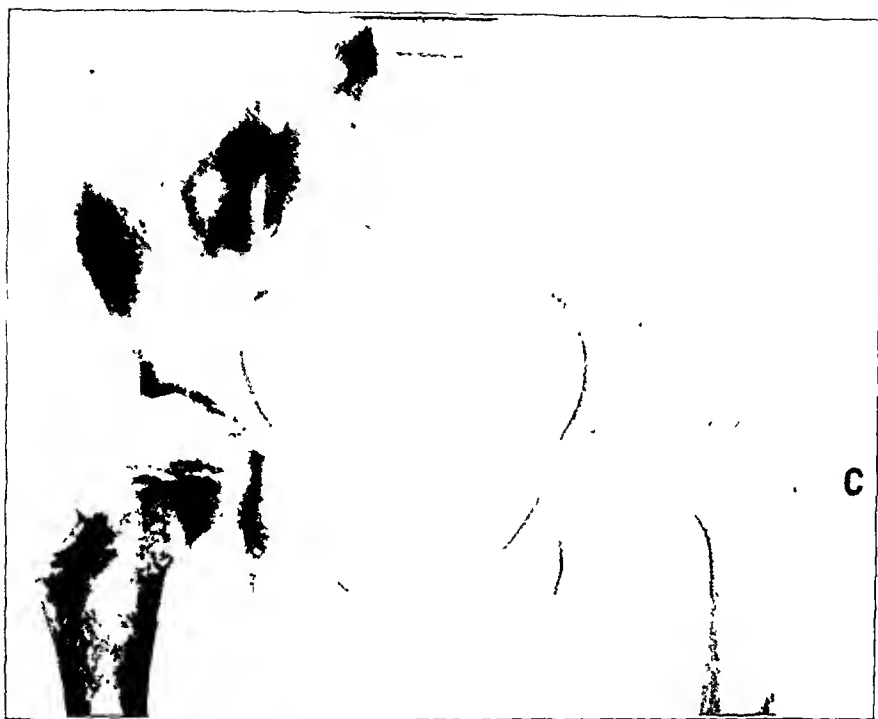


FIG. 2-C

Simple upward subluxation as the result of an inadequate superior acetabular rim. (See Fig. 1-C.)

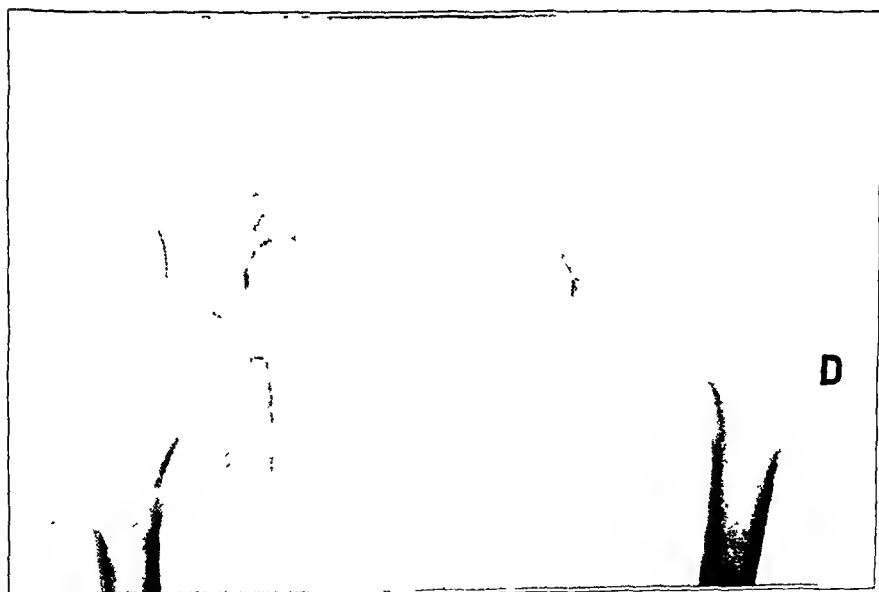


FIG. 2-D

Unilateral anterior dislocation. (See Fig. 1-D.)

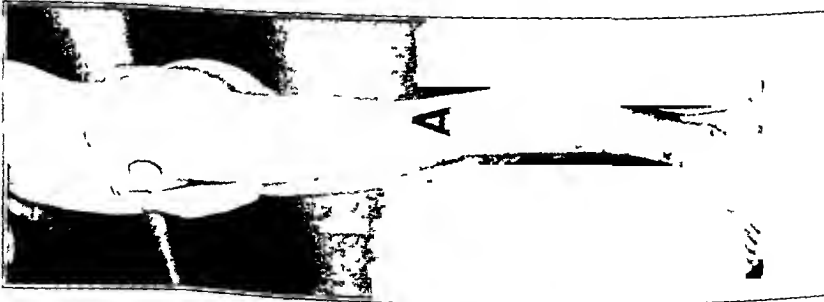


FIG. 3-A

Photographs showing characteristics of a primary unilateral anterior congenital dislocation of the left hip in a male, twenty-eight years old, who has never received treatment.

Fig. 3-A: Lateral view of dislocated hip, showing femoral head outlined with dye and pointing directly forward just back of anterior superior spine. The buttock on this side is extremely flat, and lumbar lordosis is not exaggerated.

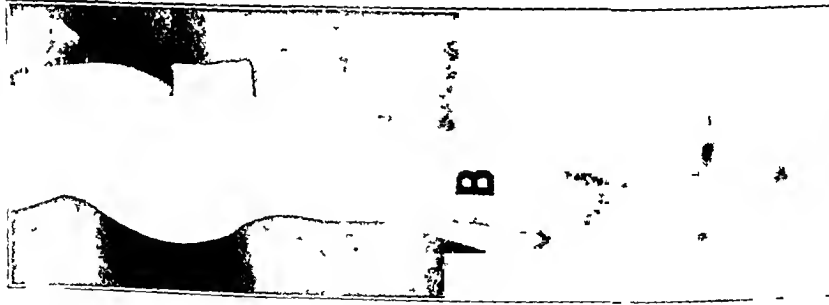


FIG. 3-B

Fig. 3-B: Lateral view of normal hip, showing normal curvature of buttock as compared with flattening seen in Fig. 3-A.



FIG. 3-C

Fig. 3-C: Anterior view, showing femoral head and anterior superior spine outlined with dye. The femoral head is pointing directly forward lateral to the anterior superior spine, but it is above the level of the spine as the result of the flattening of the buttock.

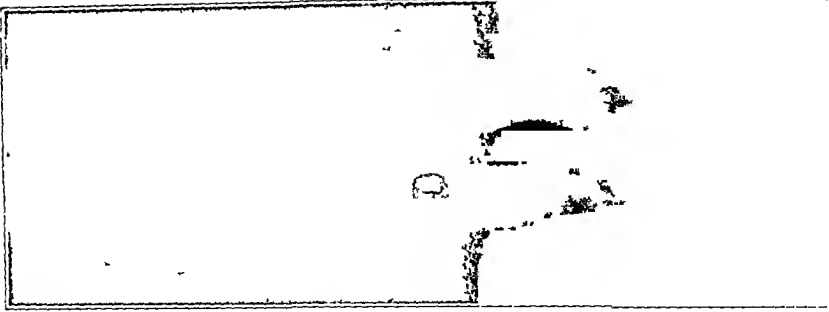


FIG. 3-D

Fig. 3-D: Anterior view, showing femoral head and anterior superior spine outlined with dye. The femoral head is pointing directly forward lateral to the anterior superior spine, but it is above the level of the spine as the result of the flattening of the buttock.

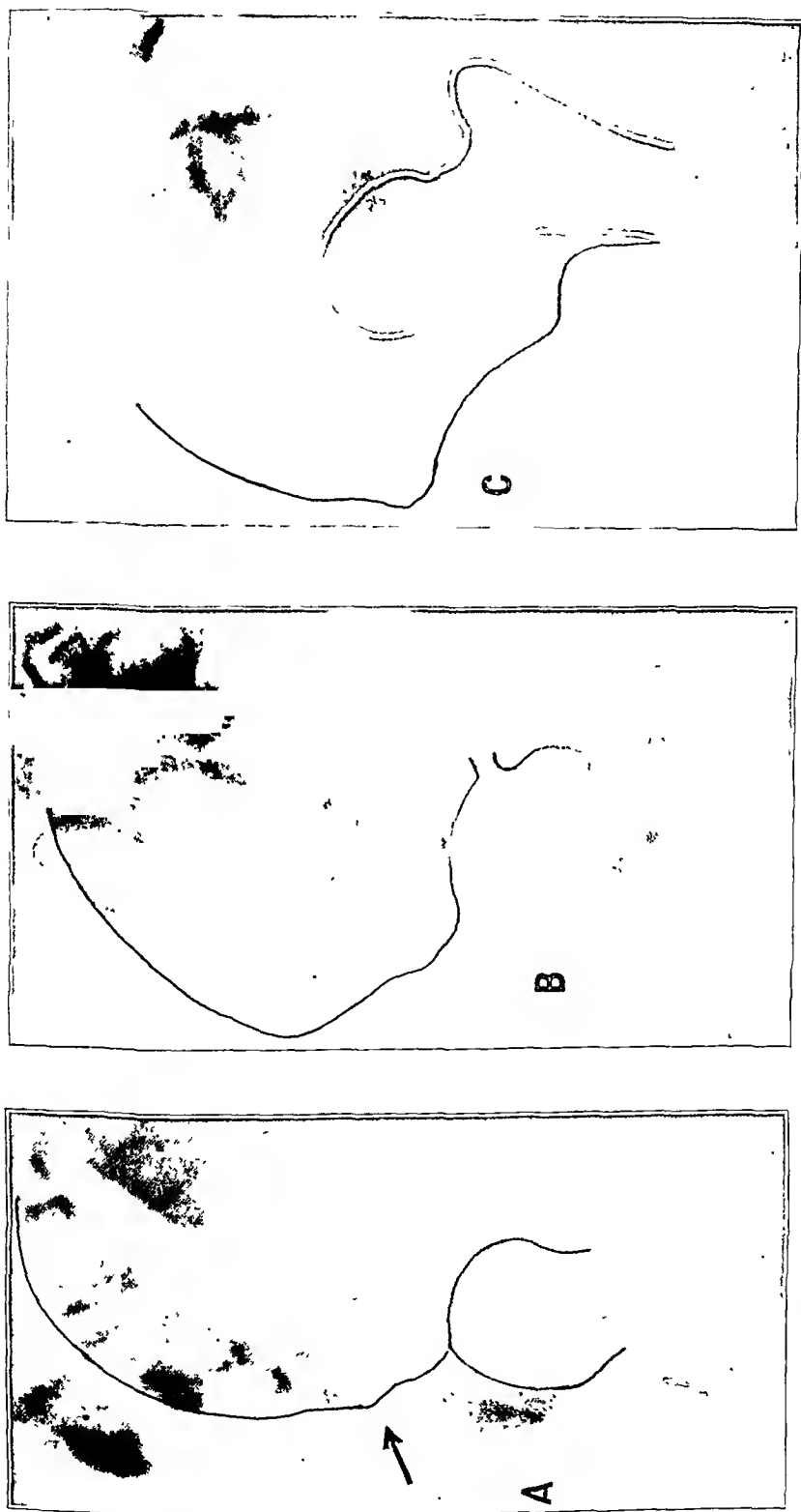


FIG. 4-A

FIG. 4-B

FIG. 4-C

Fig. 4-A: Primary anterior dislocation of femoral head to anterior superior spine. The femoral head is resting below the anterior superior spine, which is marked by the arrow. The pelvis is rolled backward as in Fig. 6.

Fig. 4-B: Lateral view of normal hip in same patient. The femoral head in this instance is resting against the wing of the ilium far posterior to the anterior superior spine. The pelvis is rolled forward as the result of the posterior thrust in the line of weight-bearing.

Fig. 4-C: Lateral view of posterior dislocation of patient in Figs. 1-B and 2-B. The femoral head is rolled forward as the result of the posterior thrust in the line of weight-bearing.

In the first six cases which were encountered either open or closed reduction, with preliminary skeletal traction, was attempted. In one case (Case 1) both procedures were given a trial, and, with the open reduction, a shelf was turned just above the acetabulum in order to increase its depth. In every instance, however, the anterior dislocation recurred as soon as weight-bearing was instituted,—this in spite of the fact that reduction in

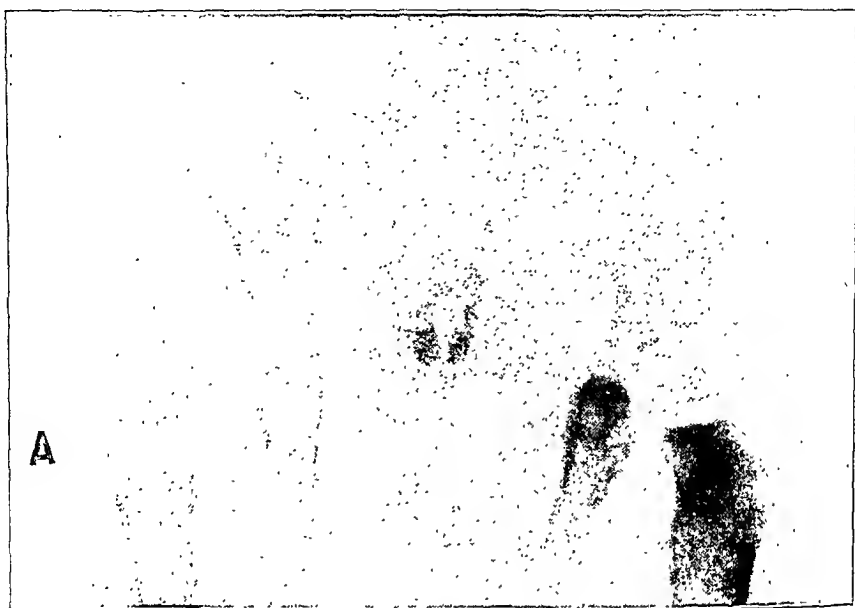


FIG. 5-A

Case 6. Unilateral anterior dislocation at the time of original admission.

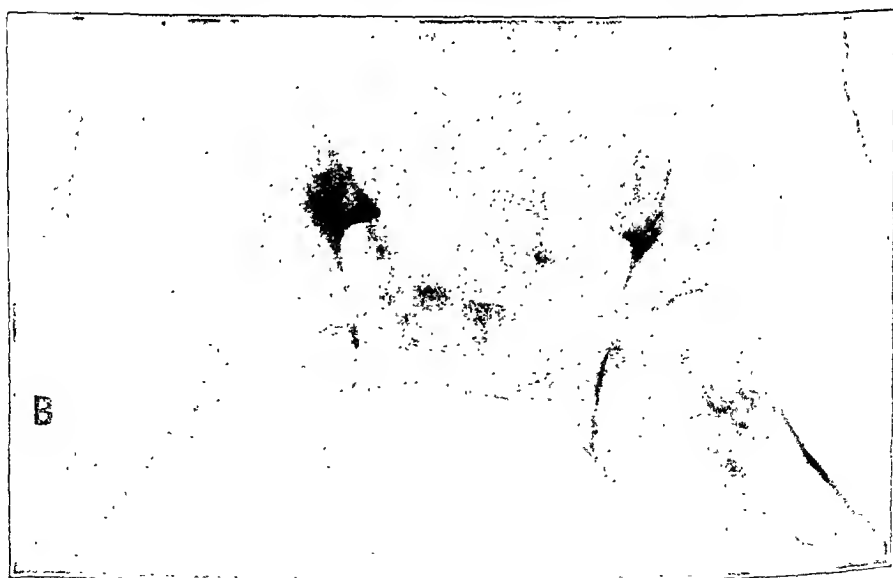


FIG. 5-B

Case 6. Showing hip in plaster after attempted closed reduction preceded by skeletal traction.



FIG. 5-C

Case 6. Recurrent anterior dislocation after weight-bearing was instituted.

each case was followed by correction of the femoral torsion with supracondylar osteotomy. Four of these cases were then followed over a two-year period without additional treatment, and during this time the

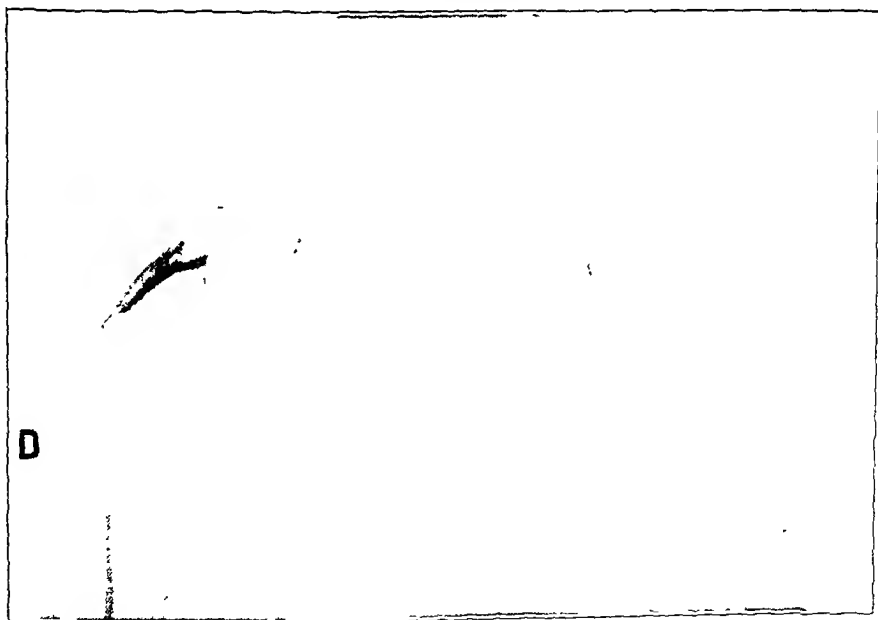


FIG. 5-D

Case 6. The head was again pulled down by skeletal traction, and the shelf operation was performed. It was impossible to reduce the dislocation at the time. This roentgenogram shows the condition of the shelf upon removal of the plaster.

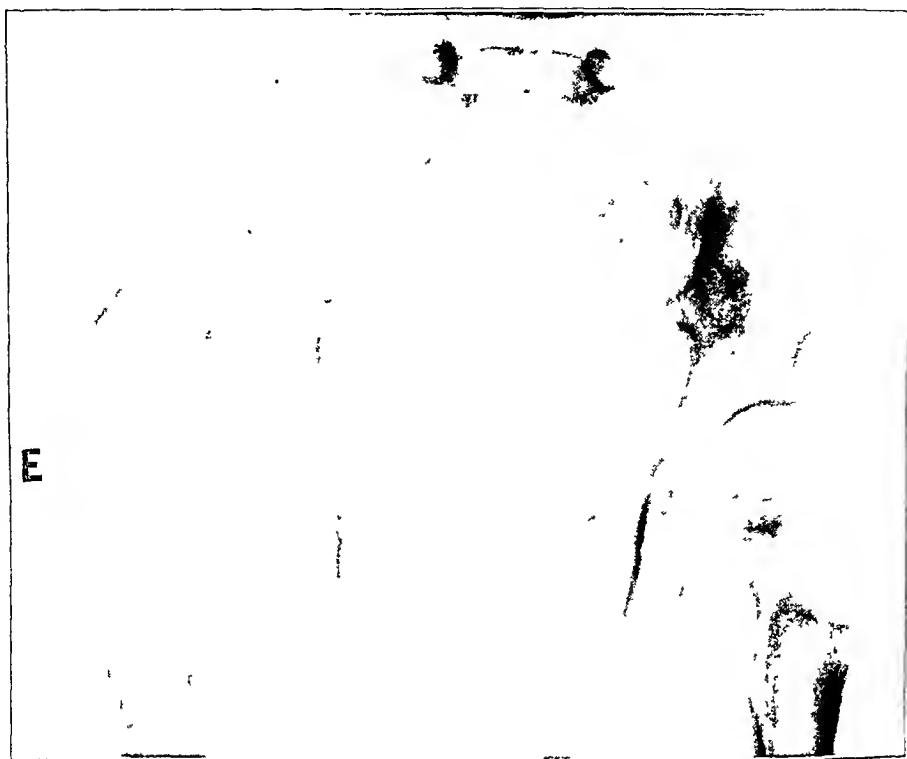


FIG. 5-E

Case 6 Condition of shelf one year after weight-bearing was instituted. Note the marked hypertrophy of the shelf as the result of weight-bearing during this time. There was no residual shortening.

affected hips remained stable with no change in the lumbar lordosis and no increase in shortening, and each patient maintained a very satisfactory gait. These patients remained symptom-free and the results seemed satisfactory from a functional standpoint during this time. Since the anterior dislocation recurred in each instance, we were wondering if attempted correction of such a dislocation was justified. We then encountered a primary anterior dislocation in a physician, twenty-eight years of age, who had never received treatment and who showed a true shortening of four and one-half inches. He stated that this shortening had been definitely progressive and had increased one and one-half inches during the last fifteen years. Except for the progressive shortening, the hip had remained symptom-free, and there was little or no evidence of mechanical disability. Because of this fact, and in view of his age, no treatment was advised. It did seem to present adequate proof, however, that an anterior dislocation is not a stable position which will remain satisfactory throughout life. Since an anterior dislocation is a satisfactory position from the standpoint of body mechanics, it does not seem to be absolutely essential that the femoral head be placed in the acetabulum. The most important factor in the treatment, then, appears to be the production of stability in order to prevent this progressive shortening in subsequent years.

The procedure we are now using in these cases is as follows:

An attempt is first made to obtain a closed reduction, because, in spite of the fact that the anterior dislocations have invariably recurred, we still have hope of obtaining a reduction some day which will be permanent. After closed methods have failed to maintain a satisfactory reduction, preliminary skeletal traction is again used in order to pull the femoral head well below its normal resting level. This is done in order to make it possible to place the shelf at a point low enough to contact adequately the weight-bearing portion of the head and at the same time to compensate for any shortening which is present. Traction is usually carried out over a period of about three weeks to assure adequate relaxation of all surrounding soft structures. Open operation is then performed, and an attempt is made to place the femoral head in the acetabulum. As a rule, this is extremely difficult, but it can occasionally be accomplished. If reduction of the head can be brought about, and if the head remains in the acetabulum after posterior pressure has been released from the trochanter, it is left in its reduced position. However, if the head tends to redislocate anteriorly, or if it is impossible to place it in the acetabulum, it is left in its anterior position. In either instance, a part of the thickened superior portion of the joint capsule is removed in order to place the shelf as low as possible. (The joint capsule is opened, if it is impossible to tell definitely by manipulation at the time just exactly what status exists. It is again closed before the shelf is turned.) A shelf of bone, approximately two inches in width, is then turned down extracapsularly over the femoral head and neck, extending from the posterior margin of the acetabulum all the way forward to include the anterior superior spine. It is brought down to a horizontal position and held securely by placing it in a notch in the soft tissues just above the greater trochanter. It is then reinforced with several grafts removed from the remaining portion of the wing of the ilium. This furnishes an adequate shelf of bone, which extends all the way forward to the anterior superior spine and lies directly above the femoral head, if the hip is in an anterior position or if the anterior dislocation recurs after the femoral head has been placed in the acetabulum. Femoral torsion is invariably present in these cases, and, in order to place the femoral head well beneath the shelf of bone, the extremity is held in a position of marked internal rotation. The wound is then closed, and a bilateral hip spica is applied with the extremity held in a position of about 35 or 40 degrees of abduction and in marked internal rotation. Immobilization in this plaster is continued for three months, at the end of which time the femoral torsion is corrected by supracondylar osteotomy. After the osteotomy, immobilization in plaster is again maintained for two months.

In a few of these cases an inadequate anterior rim of the acetabulum has been demonstrated, and we have considered an attempt to reconstruct the acetabulum in such a way as to increase its depth, or to rebuild this anterior rim in order to maintain adequate reduction. These, however,





FIG. 6-A

Case 1. Unilateral anterior dislocation of left hip at time of original admission at the age of four years.



FIG. 6-B

Case 1. Apparent spontaneous reduction following skeletal traction.



FIG 6-C

Case 1. Recurrent anterior dislocation after closed reduction and one open reduction.



FIG 6-D

Case 1 Condition five years later, after additional skeletal traction and shelf operation. It was impossible to reduce the dislocation of the head at this time. In this roentgenogram it appears that the dislocation is well reduced, but, as a matter of fact, the head is in an extreme anterior position. This proves that simple anteroposterior views of the pelvis cannot be relied upon for determining reduction in this type of hip

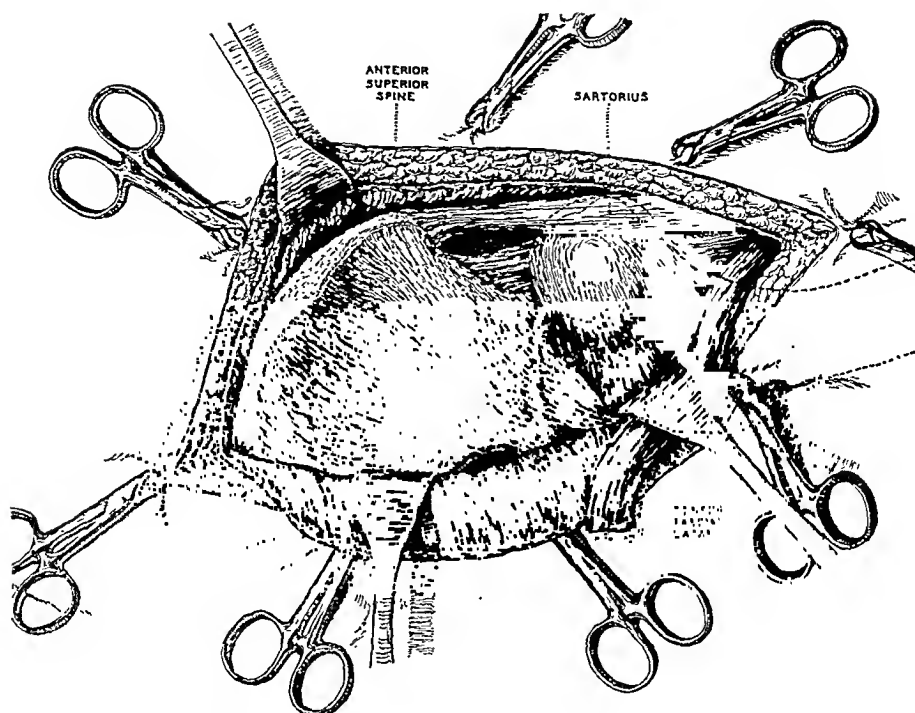


FIG. 7-A

Semidiagrammatic drawing, showing relationship of femoral head to anterior superior spine at time of operation. The femoral head has been pulled slightly below its usual resting level as the result of preliminary skeletal traction. The femoral head points directly forward and is covered by the joint capsule.

would be much more extensive surgical procedures, accompanied by many technical difficulties, and, while these procedures have not been tried, we are not convinced that either would be as satisfactory as the one we are now using.

## RESULTS

With one exception, results in the nine cases in which the described procedure has been used thus far have been very satisfactory. All have shown a free range of painless motion within three months after removal of the plaster, and, although shortening of as much as one-half an inch has been encountered, there is usually no residual shortening. The Trendelenburg sign has been absent in all cases except three, and the patients have been able to walk without a perceptible limp. An inadequate shelf was obtained in each hip of our initial operative case (Case 5), and very little evidence of these shelves remained after one year. Reconstruction of these shelves was recommended, but refused, and the result in this case has been listed as unsatisfactory. In three of the nine cases operated upon, it was possible to hold the femoral head in the acetabulum at the time of the shelf operation. In only one of these, however, was this normal relationship maintained after weight-bearing was instituted, and this case has been followed for only six months after removal of the final plas-

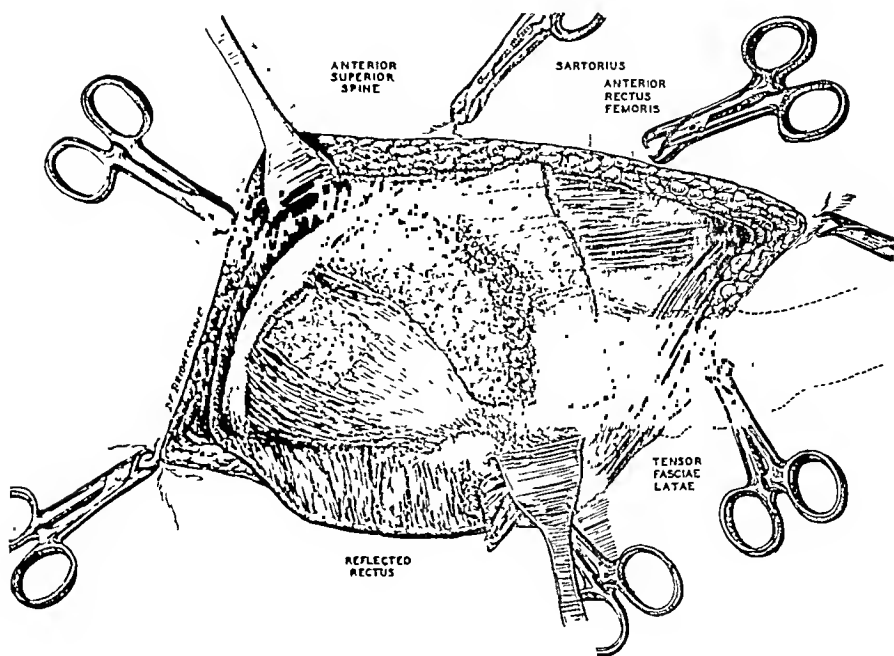


FIG. 7-B

This drawing shows the dislocation of the femoral head reduced in the acetabulum with the extremity held in extreme internal rotation in order to restore the trochanter to its normal lateral position. A massive shelf is then turned as shown, extending from the posterior margin of the acetabulum forward to include the anterior superior spine and reinforced with grafts removed from the posterior portion of the wing of the ilium. If the anterior dislocation recurs, as is usually the case, it will still be resting beneath a satisfactory bone shelf.

ter. In the other two, redislocation in an anterior position occurred almost immediately after the patients became ambulatory. In the case in which the dislocation has remained well reduced, it is obvious that the large shelf of bone was not utilized in weight-bearing, and, as a result, this shelf had almost entirely disappeared after six months. In the remaining cases, however, in which the hips were either left in an anterior position or subsequently redislocated anteriorly, the shelves showed no tendency to decrease in size. In fact, the only change which has taken place thus far has been increase in size and density of the shelf. This is due to the fact that the femoral head is resting directly beneath the shelf, and it hypertrophies as a result of the stress and strain which is placed against it. It is a well-recognized fact that no bone shelf will persist unless it plays a rôle in the weight-bearing portion of the hip. Obviously, none of these cases has been followed long enough to make any definite statement about the ultimate end result, since only one case has been followed for as long as one year after removal of the final plaster. We can only state that the immediate end results have been entirely satisfactory, and we feel that these massive shelves should maintain stability in these hips and prevent progressive shortening as the patients increase in age and weight.

## SUMMARY

Primary anterior congenital dislocation of the hip does exist as a true clinical entity. The findings are such that it can be accurately differentiated from the more common posterior dislocations or the simple upward subluxations. Each of the ten cases reported has presented the following cardinal characteristics:

1. Lumbar lordosis is absent.
2. There is less shortening in such individuals than is usually seen in the other two types.
3. The buttock on the affected side is flatter than normal.
4. A bulge is present anteriorly just below the anterior superior spine, marking the position of the femoral head, which can often be outlined visually.
5. The femoral head can be felt pointing directly forward just below the anterior superior spine.
6. Lateral roentgenograms of the pelvis reveal a true anterior position.
7. All anterior dislocations have recurred following closed reduction, even when preceded by preliminary skeletal traction.

The treatment now being used in these cases consists of preliminary skeletal traction followed by attempted closed reduction; if this is successful, the torsion is corrected by supracondylar osteotomy. In our experience, however, the anterior dislocations have invariably recurred after weight-bearing was instituted. Preliminary skeletal traction is again used, and, at open operation, an attempt is made to reduce the femoral head, although this is usually impossible. In either instance, a wide shelf of bone is placed extracapsularly above the femoral head along the superior rim of the acetabulum, extending forward to include the anterior superior spine. In this way adequate stability is assured even though reduction is not possible or does not persist. Results in these cases have been entirely satisfactory up to the present time, although no case has been followed longer than one year after removal of the final plaster.

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## VERTEBRAL LESIONS IN UNDULANT FEVER

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The first case of undulant fever to be reported in the United States was recorded by Craig in 1905. Even in 1927, when 112 cases were reported, the disease was considered to be endemic in the Southwest and Midwest. During 1929, the number of reported cases reached 1305, with at least two from each state. Since then, it has become a national public-health problem. In 1937, there were 2497 reported cases, and the preliminary reports for 1938 indicate a continued increase.

Undulant fever is a general infection caused by one of the sub-species of *brucella melitensis* and in the active period is characterized by a septicaemia. This fact probably accounts for the occurrence of arthropathies and other local manifestations.

### OCCURRENCE

As revealed by a recent review of the literature, joint symptoms are a common complaint in the acute stage of the disease. In reporting 550 cases occurring in two widely separated epidemics, Hardy and his co-workers and Simpson independently recorded approximately one-third of these patients as having had severe arthralgia. More recently, Goldfain reported a positive agglutination test for undulant fever in eighty of 157 consecutive cases with the complaint of chronic arthritis.

Reports of suppurative lesions are much more rare in the English literature. Strachan, in a thesis on an epidemic of undulant fever occurring in South Africa in 1911, recorded 268 cases, in which joint swelling and effusion occurred in 15.3 per cent., cold abscesses in 1.86 per cent., suppurative hip-joint disease in one case, and a psoas abscess in another. In 1932, Kulowski and Vinke reported a destructive lesion involving the lumbar spine with abscess formation from which *brucella melitensis* was isolated. The following year, O'Donoghue reported a case of suppurative arthritis of the hip, due to the same organism, which went on to bony ankylosis. In 1935, Snyder reported two cases of spondylitis in children. In a second report from Steindler's Clinic in 1936, Kulowski reported another case of spondylitis, one of suppurative arthritis of the wrist, and two of osteomyelitis, due to organisms of the *brucella* group.

Localization in the spine seems to be the most common bone and joint complication of undulant fever. Even though there are only four cases recorded in the English literature, many reports, usually of single cases, have appeared in foreign journals. In 1934, Palagi, of Florence,

gave a detailed description of the clinical and pathological condition, reporting seventeen of his own cases and collecting twenty-nine others from the literature.

The localization of the organisms in the spine may occur in any phase of the disease, although it is more common in the convalescent period. At times the process appears to be independent of the previous illness from which the patient has apparently recovered. Serio suggested that it is a local recurrence of the Malta fever, probably due to a lack of immunization to the organism.

With regard to sex, Palagi was not able to confirm the opinion of other authors that this complication occurs more often in males, but adults are affected more frequently than children (seven to one).

#### ETIOLOGY

As to the organism, all three sub-species of the brucella group — *melitensis*, *abortus*, and *suis* — have been cultured from the local lesions. However, to attempt differentiation at this time is impractical as their clinical course is thought to be identical.

#### PATHOLOGY

It is interesting to note that most of the cases of undulant-fever spondylitis reported in humans have occurred in the lumbar region. Of the fifty-six cases, the distribution was as follows: lumbar, forty; thoracolumbar, ten; thoracic, four; and cervical, two.

There are no pathological reports from human cases, but Feldman and Olson found ten lesions in the lumbar vertebrae and eight in the lumbosacral region in twenty-three hogs with vertebral involvement. They were able to recover the organism from ten of these cases. The pathological process seemed to originate in the epiphysis and formed irregular abscesses in the bodies of the vertebrae and the intervertebral discs (Fig. 1). These were usually from five-tenths of a centimeter to three centimeters in diameter and contained grayish white, thick, pasty or caseous material and occasionally a sequestrum. Certain lesions presented a crescent-shaped, cap-like inflammatory proliferation of osteogenic tissue bridging the intervertebral space on the ventral surface of the affected vertebrae. They concluded that the amount of ossification is variable, depending on the duration of the lesion. Their gross description of these lesions in hogs is compatible with the roentgenographic picture in human cases.

Serio divided these spinal complications into the acute and the chronic forms. The former (Figs. 2-A and 2-B) assumes the type of acute osteomyelitis with suppuration and occasionally abscess formation and with eventual fusion of the vertebral bodies. In the chronic form, the process is represented by the appearance of bone spurs, usually on the anterior surface of the bodies (Figs. 4-A and 4-B).

The roentgenographic reports naturally vary according to the stage of the disease. However, there are certain findings common to the many

reports, and, although not pathognomonic of the disease, they are considered to be characteristic.

Most authors agree that the initial change in the spondylitic process consists usually of a focal lesion on the vertebral body, demonstrable by the changes in calcification. Instead of decalcification, as seen in the active stage of tuberculosis, and of considerable importance in the differential diagnosis, there is a characteristic zone of sclerosis beginning at the site of the original focus. This accompanies the infiltrative process, which gradually extends to involve the entire body and at times the various processes (Figs. 2-A, 2-B, 3-A and 3-B).

A study of the roentgenograms and descriptions of these lesions reveals a variability of the site and extent of the lesion. In some, it invaded only an angle of the vertebral body, occasionally both or all of the surfaces. It may be confined to the disc, but seldom results in narrowing of the intervertebral space by more than one-half. In such cases, there is usually involvement of a part of the adjacent vertebral surface.

The contour of the body often remains normal and practically always appears sclerotic or irregular. Very frequently, the initial lesion in the body is masked by concomitant periosteal reaction as evidenced by spur formation (Figs. 2-A through 4-B). These frequently appear only at the anterior margins of the bodies, but occasionally they are also seen in the anteroposterior view to follow the contour of the disc. A rare occurrence is involvement of the intervertebral articulations.

The cases studied in the more advanced stage of the process revealed



FIG. 1

Spondylitis in a male hog, one and one-half years old, showing heavily encapsulated abscess involving the body of the last lumbar and the first sacral vertebrae. An organism of the brucella group was obtained from the spleen of a guinea pig inoculated with a portion of emulsion from the lesion. (From *Archives of Pathology*, courtesy of Dr. W. H. Feldman, Dr. Carl Olson, Jr., and the American Medical Association.)





FIG 2-B



FIG 2-A

Roentgenograms of the lumbar spine showing the early changes before onset of acute clinical symptoms. Note the focal lesion at the anterior border of the upper surface of the fourth lumbar vertebra, the narrowing of the intervertebral disc, the early sclerotic changes in the bodies, and the beginning periosteal-spu formation in the lateral view



FIG. 3-B

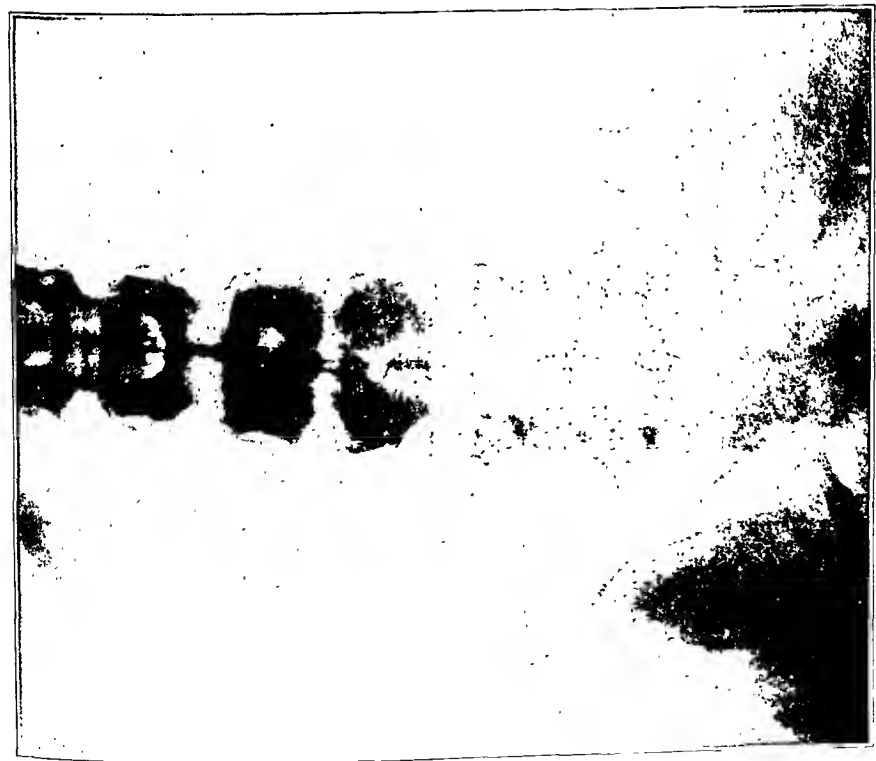


FIG. 3-A

Roentgenograms of the same lesion as shown in Figs. 2-A and 2-B, six weeks later. Note the preservation of the intervertebral space, the marked sclerosis of the involved vertebra, and the lip-like spur formation at the anterior border in the lateral view.

a constant and characteristic roentgenographic picture. All showed a reactive change—increased calcification of the bodies, circumscribed or diffuse—with proliferation of bone spurs across the interspace. Occasionally, in the more severe cases, there was some deformity of the body or involvement of the articular facets. Bony fusion of the bridges between the adjacent bodies was a common finding.

#### SYMPTOMATOLOGY

Pain naturally is the important symptom. It may come on gradually, but in the greater number of cases it occurs suddenly. Most authors agree that the pain is constant in nature, severe in intensity, and characterized by exacerbations, either coming on spontaneously or precipitated by movement, coughing, etc. The pain is said frequently to radiate along the nerve trunks. In short, the onset is sudden, the symptoms are acute, and the pain is more severe than in Pott's disease. The disease approaches the picture of infectious spondylitis, differing only in its more benign clinical course.

Vertebral rigidity is usually



FIG. 4-A



FIG. 4-B

Roentgenograms of the cervical spine soon after the onset of clinical symptoms. The lipping at the anterior border between the third and fourth cervical vertebrae, seen in the lateral view, is described as characteristic of the chronic lesions. Note the changes in the fifth and sixth cervical vertebrae, which are thought to represent a more fulminating infection.

quite pronounced. The muscle spasm varies from a rather localized area in the milder cases to diffuse involvement, with rigidity of the entire spine, when the lesion is extensive or when the intervertebral articulations are involved.

Even though the lumbar region is the usual site of the disease, deformity is rare, because the destructive process is seldom extensive enough to produce clinical changes.

Abscess formation is not nearly as common as in tuberculosis. Of the known cases, invasion of the paravertebral tissues occurred in only 12.5 per cent.

With regard to the general symptomatology, there is but little of diagnostic importance other than the fever and perhaps the generalized aching pain.

#### DIAGNOSIS

Vertebral lesions of undulant fever may be suspected in patients suffering from back pain, who are known to have had the disease recently, or in those who have had some of the symptoms, even though their cases have not been diagnosed as undulant fever.

In the cases recorded in the literature diagnosis was made by the serological and roentgenographic findings, seldom by culture (3.6 per cent.). This is due to the relatively rare occurrence of abscess formation (12.5 per cent.), and the technicalities encountered in growing the organism.

Diagnostic aids are the low white count and the elevated temperature concomitant with the relatively high sedimentation rate (average, sixty-eight millimeters per hour—Sandström). Repeated negative tuberculin tests and a negative Widal test are valuable in the differential diagnosis.

Roentgenographic evidence of an infectious process, characterized by increased density of the vertebrae involved, preservation of the body contour, relatively minor changes in the intervertebral disc, and hypertrophic spurring, is significant (Figs. 2-A through 4-B).

The positive agglutination test, opsonic index, and skin test, or the recovery of the organism from the urine, the blood stream, or the abscess are rather conclusive.

#### TREATMENT

The treatment is medicosurgical. All authors agree that treatment of the systemic infection is of paramount importance. Of the seven cases with abscess formation, only two required incision and drainage. Kulowski, in a subsequent article, warns against secondary infection, which occurred in the case reported by Vinke and himself.

Of the fifty-six recorded cases, only the two reported by Kulowski were treated by surgical fusion. European authors followed the precedent of Roger and employed symptomatic measures during the acute stage of the disease, followed by support in the convalescent period. All reported equally good results with eventual spontaneous fusion in those cases with extensive changes in the body contour, and only local hypertrophic spurring in those cases with less involvement.

#### CASE REPORT

L. G., a colored female, aged forty-seven, was treated for undulant fever at St. Anthony's Hospital in May 1937. At that time, she had generalized aching pain, worse in the lumbar region. Roentgenograms were negative. She was discharged from the

Out-Patient Department six weeks after admission to the Hospital, as having satisfactorily recovered. Minor complaints persisted, but the symptoms were not severe enough to cause her to return for treatment until about the first of July 1938. Roentgenograms taken at that time (Figs. 2-A and 2-B) revealed an early destructive lesion. Two days later, the patient fell down and injured her back. The pain became more severe, and she was confined to bed for the first time since leaving the Hospital.

The patient was referred to the Orthopaedic Out-Patient Department of the University Hospital on July 12, 1938, because of the increase in symptoms. Examination at that time revealed marked muscle spasm, limitation of motion in the lumbar and lower thoracic spine, and tenderness over the mid-lumbar area. A roentgenogram showed a lesion between the third and fourth lumbar vertebrae. The temperature was normal. A plaster jacket was applied, and the patient was returned home to rest on a firm bed. She was referred to the Hospital five weeks later, because of the persistence of symptoms, with a diagnosis of undulant-fever spondylitis.

On admission to the Medical Service on August 19, 1938, the laboratory findings were as follows:

Red Blood Cells.....	4,890,000
Hemoglobin.....	11.7
White Blood Cells.....	6,150
Sedimentation Rate.....	86 per cent.
Urine.....	Negative

The agglutination test for undulant fever was strongly positive in 1 to 200 dilution. The State Laboratory later reported a positive opsonic index and the recovery of *brucella suis* organisms from samples of the patient's blood submitted soon after admission.

Treatment consisted of systemic and symptomatic measures. The temperature on admission was 98 degrees Fahrenheit and remained within normal limits except after foreign-protein-shock treatments (Typhoid Vaccine I.V., X 7). She also received sulfanilamide in doses of fifteen grains per twenty pounds of body weight over a period of one week. Symptoms persisted in milder form. Except for blood culture, the laboratory findings were repeatedly as already recorded. The patient's general condition remained good.

Soon after transfer to the Orthopaedic Service, a spine fusion was done (October 27, 1938), followed by uneventful recovery. About this time, the patient began to complain bitterly of pain in the arms, of occipital headache, and of pain in the neck. Roentgenographic examination on December 3, 1938, showed two lesions in the cervical spine (Figs. 4-A and 4-B). Treatment consisted in head traction, which resulted in the immediate relief of all symptoms except the arm pain. This, however, had also completely subsided before discharge from the Hospital on February 1, 1939.

The patient returned to the Out-Patient Department one week later, walking unassisted. There was no muscle spasm in the lumbar spine, but motion was limited in the cervical region. She has not recovered after seven months, but is greatly improved.

#### SUMMARY AND CONCLUSIONS

The case reported is the fifty-seventh case of spondylitis complicating undulant fever to be recorded. *Brucella suis* was isolated from the blood stream soon after the development of the local lesion, which occurred over a year after the initial infection. The lesion in the lumbar region was treated by surgical fusion, and the cervical lesions, by support, with improvement after seven months.

The clinical appearance is the result of the hematogenous localization of bacteria, ordinarily in the osseous marrow, but exceptionally in the disc in young individuals. The roentgenographic findings demonstrate a

spreading process of the infiltrative type in which there is a reactive phenomenon, proliferative in nature, and characterized by endosteal and periosteal reaction. The result is sclerosis of the body with hypertrophic spur formation. There is little tendency to invasion of the paravertebral tissues.

This complication originates usually in the convalescent stage of undulant fever, but may make its appearance at any time. It is accompanied by a febrile reaction, and is characterized by the acuteness of the symptoms and a benign clinical course.

The treatment is medical and surgical. Recovery is the rule.

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# COMPRESSION FRACTURES OF THE LATERAL TIBIAL CONDYLE AND THEIR TREATMENT

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Cases of fractures of the superior tibial articular surface are becoming increasingly common as greater attention is being paid to the clinical observation and roentgenographic examination of "distortion" injuries of the knee. The Scandinavians Hultén and Mikkelsen published studies on the subject in 1929 and 1934, respectively.

These fractures vary greatly in type,—they may occur as avulsion fractures, splitting fractures, or compression fractures. This paper, however, deals only with the compression fractures of the lateral condyle of the tibia, which have their origin in a violent abduction movement in the knee joint.

An *abduction trauma* may cause the external margin of the lateral femoral condyle to press against the central part of the tibial condyle, the contact between the surfaces in subluxation thus becoming reduced. (See Figure 1-A.) Any force, either direct or indirect, applied toward abduction will be a violence with leverage. The femur will form a lever of the first kind, whose long arm ( $A$ ) will transmit the acting force ( $K$ ) and whose short arm ( $A_1$ , the breadth of the articular surface) will transmit the resisting force produced through the tensing of the ligaments ( $K_1$ ). As long as the forces are balanced, the static moments—that is, the force multiplied by its lever arm—will be equal ( $K.A = K_1.A_1$ ). The pressure ( $F$ ) between the margin of the femoral condyle and the tibial condyle will equal the total load on the lever,—that is,  $K$  plus  $K_1$ .

Should the load on the lever exceed the limit of tensile strength of the tissues, the lesion may take one of two forms: either *fracture*, resulting from the pressure between the condyles, or *rupture*, resulting from the tension in the ligaments. A tension injury will relieve the pressure between the condyles and, in most cases, no fracture will result. If, on the other hand, the ligamentous structures resist the strain longer than the bone, the ligaments may be relieved of their burden and saved from rupture by the sinking of the margin of the femoral condyle into the articular surface of the tibial condyle. Subluxation in abduction will then take place, diminishing the distance between the ligamentous insertions and thus relieving the tension on the tibial collateral and cruciate ligaments. *Consequently, pressure injuries and tension injuries have a tendency to alternate.*

However, the abduction trauma may cause two types of fracture,—splitting or compression (Figs. 1-C and 1-D).

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In *compression fractures*, the central part of the tibial articular surface is pressed down into the spongiosa. The condylar margin forms a wall, which sometimes resists the strain of the tilted and therefore wedge-shaped femoral condyle, penetrating into the bony substance, in which case the fracture is entirely intra-articular. In most cases, however, the margin fractures in several places, and the fragments are pressed out into a widened periphery. The fracture may also affect a part of the condyle, extending even to its periphery.

Most authorities agree that the change in form of the tibial condyle, resulting from a compression fracture with pronounced dislocation, has an extremely deleterious effect on the articular function, due to altered tension of the ligaments and articular dysfunction, and leads in a large percentage of cases to severe arthrosis deformans (Burekhardt, Hultén, and Lassmann).

Fractures of this kind and their complications cannot be rationally treated by manipulation. Undoubtedly, therefore, surgery is indicated. However, a rather special diffi-

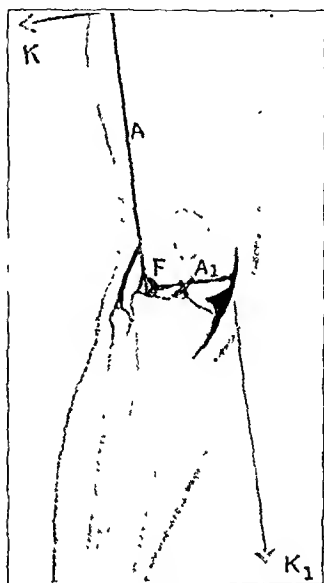


FIG. 1-A

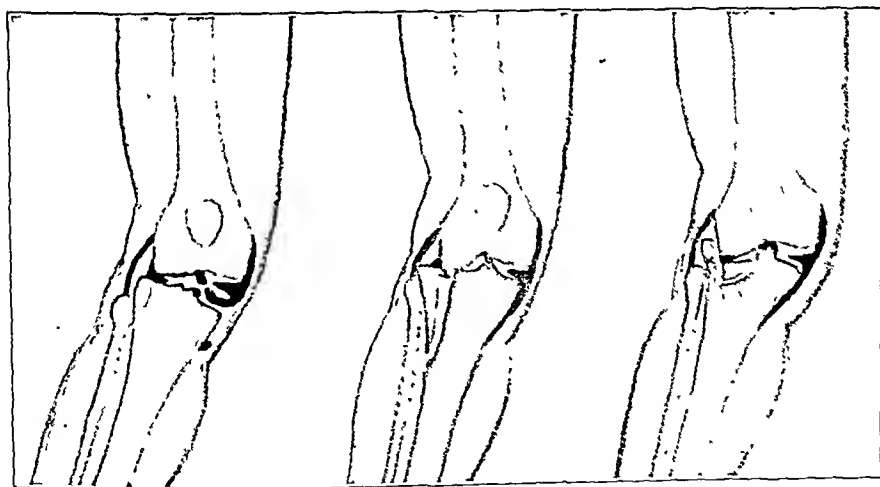


FIG. 1-B

FIG. 1-C

FIG. 1-D

The effect of an abduction force on the knee joint.

Fig. 1-A: The femur is a lever, its length ( $A$ ) being one of the arms, and the breadth of the articular surface ( $A_1$ ), the other. The load on the fulcrum ( $F$ ) will be the sum total of the forces  $K$  and  $K_1$ .

Fig. 1-B: If the limit of tensile strength is exceeded, a *tension* injury may occur, rupturing the ligaments transmitting the tension.

Figs. 1-C and 1-D: If the ligaments hold, a *pressure* injury may occur, probably of the splitting-fracture (Fig. 1-C) or the compression-fracture (Fig. 1-D) types. The resulting subluxation and shortening will relieve the ligamentous apparatus of its burden.



culty attends the operative treatment of these fractures. The squeezing together of the cancellous tissue of the epiphysis reduces the latter's volume. A space remains after reposition, which must be filled if the operative result is to be permanent.

The literature of recent years, particularly the French, contains any number of reports on operated cases. It is agreed that reposition cannot be effected without arthrotomy. Attempts have been made to fix the fragments with two or more screws inserted in different directions, occasionally combined with a bone graft from the tibial diaphysis. However, it is difficult to make the screws function in the partially crushed cancellous tissue.

The desirability of inspecting the lateral meniscus makes arthrotomy still more advisable. It is often severely injured, torn from its synovial insertion, and pressed down into the hollow caused by the fracture. Meniscectomy is then unavoidable. Sometimes it may appear possible to repair the damage. However, in two cases published by Lehmann, in which the meniscus had been sewed to a torn synovial insertion, meniscal troubles appeared later. In this type of fracture, Stumpfegger recommends meniscectomy, even of an uninjured lateral meniscus, since otherwise the meniscus attaches itself to the injured tibial condyle, thus reducing the joint's rotative capacity.

Consequently, in the treatment of these fractures it is more important to inspect the lateral half of the joint, in order to make sure that reposition has been effected and, if necessary, to repair or to remove the lateral meniscus. The joint is, therefore, best opened by means of a short lateral parapatellar incision, extending downward over the tibial condyle. If the meniscus is destroyed, the first step in the operation is its removal. If it is intact, however, it must generally be divided in order to inspect the articular surface. The division should be done medially through the well-vascularized, fibrous insertion of the meniscus rather than through its cartilaginous substance, which is practically incapable of regeneration.

There is no need to expose the outer aspect of the tibial condyle in order to inspect the places where the fractures may have reached the surface, since the reduction can be verified most efficiently through the joint.

The space under the fragments is made accessible by chiseling a hole, one and five-tenths centimeters in diameter, under the outer aspect of the lateral condyle near the ligamentum patellae. The plug of bone obtained can be replaced after reposition.

With an elevator inserted through the canal and under the fragments, it is then possible to lift the latter into position and, at the same time, to examine the articular surface. At times it is also necessary to exert pressure over the lateral area of the joint, in order to bring the scattered fragments back into position.

The reposition of the fragments, however, leaves a hollow in the cancellous tissue of the tibial epiphysis, which must be filled if the reposition is to be permanent. Suitable material from the body itself is not

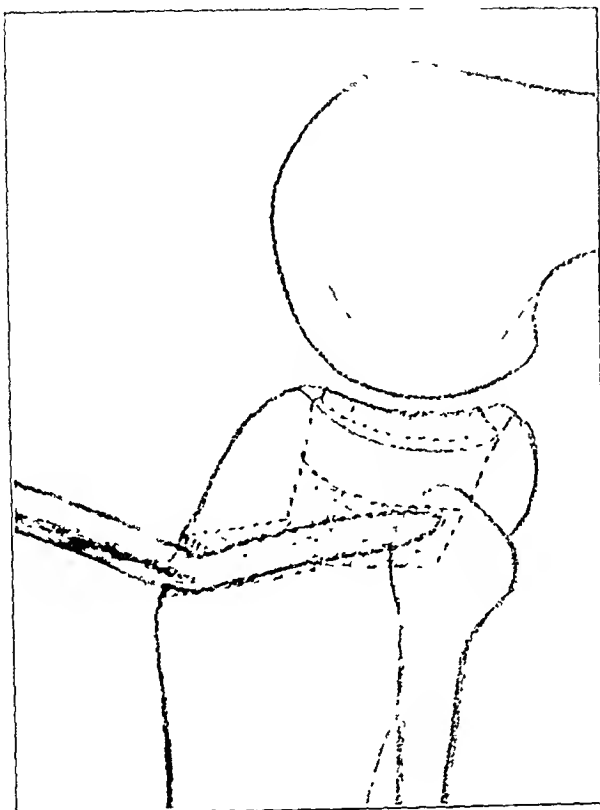


FIG. 2-A

The fragment is replaced by means of a bent elevator (Fig. 2-B), which works as a lever with its fulcrum supported at the orifice of the chiseled canal where the bone is compact. The shaded area represents the space to be plugged with spongy os purum.

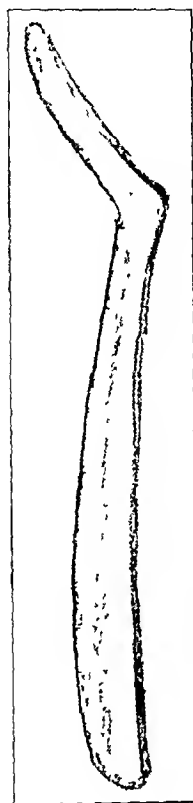


FIG. 2-B

Showing a suitable elevator.

available for the plugging of this hollow. However, os purum, an albumin-free, animal-bone preparation, put up in both spongy and compact form, is equally good. After boiling in a physiological salt solution, spongy os purum becomes practically plastic and easy to cut and mold. Suitably sized pieces are placed in the hollow and carefully packed together. This is done under counterpressure from the articular surface and outer aspect of the condyle, which enables even packing and provides a smooth foundation for the fragments of the articular surface. The plug of bone is replaced and fixed with a few periosteal sutures; the meniscal insertion is sewed with buried stitches; and the joint is closed. (See Figure 2-A.)

Good reposition and a suitable foundation for the raised fragments are obtained by this method. The substance which plugs the hollow inside the epiphysis does not irritate the surrounding bone tissue, but provides a supporting network for its new growth. Due to the tension in the blood-soaked substance and to the fixation of the pieces of os purum to the surrounding tissue and to each other, the filling is extraordinarily



FIG 3-A

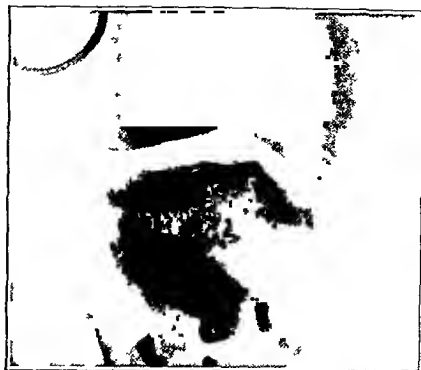


FIG 3-B

The patient was a woman of thirty, who had fallen from a height

Fig 3-A Before reposition

Fig 3-B After reposition and plugging Follow-up for more than one year showed unchanged reposition and normal articular function

firm, which can be ascertained by exerting pressure on the articular surface.

Our ruling principle in the postoperative treatment of these injuries has been relatively early mobilization, but with a long period in which the patient is not permitted to place weight on the leg. Some time naturally elapses before the injured condyle can bear the weight of the body. It is also important, through early mobilization, to attempt to prevent adhesions between the meniscus and the articular surface and obliteration of the capsular recesses, leading to troublesome post-traumatic rigidity. Therefore, after three weeks, the circular plaster cast is exchanged for a removable one, and the patient is permitted to exercise the joint in the least strenuous manner,—that is, in water. Not before ten to twelve weeks have elapsed is the patient allowed to place weight on the leg.

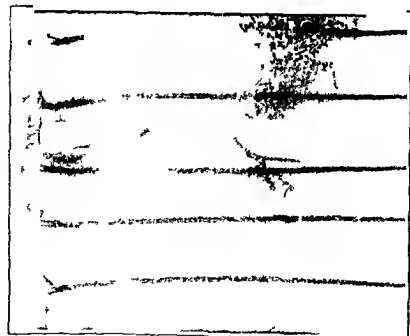


FIG 4-A



FIG 4-B

The patient was a man, aged fifty-eight years, who had been hit by a car

Fig 4-A Before reposition

Fig 4-B Ten months after reposition and plugging Follow-up for more than one year showed unchanged reposition and almost normal articular function



FIG. 5-A

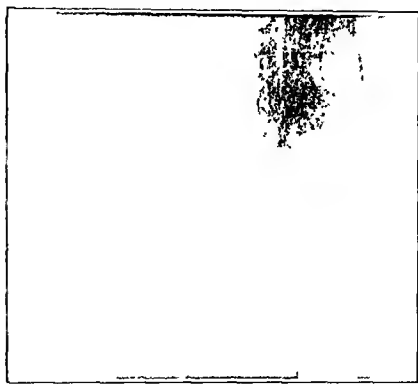


FIG. 5-B

The patient was a man, thirty-five years old, who had fallen from a height.

Fig. 5-A: Before reposition.

Fig. 5-B: Four months after reposition and plugging. Patient still undergoing treatment.



FIG. 6-A

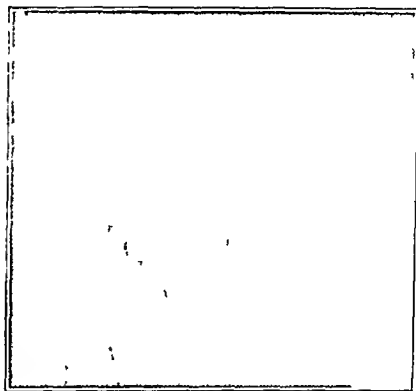


FIG. 6-B

The patient was a man, twenty-five years of age, who had been injured while wrestling.

Fig. 6-A: Lateral view before reposition.

Fig. 6-B: After reposition. Patient still undergoing treatment.

Fourteen cases of compression fracture of the lateral tibial condyle have been operated upon according to this method at the Surgical Department of Sabbatsberg Hospital, Stockholm. The operations have been performed a few days after the accident. In none of the cases have there been any postoperative complications. Eight of these patients have been followed up for more than one year and show undisturbed reposition and a stable joint with normal or almost normal mobility.

#### SUMMARY

Available follow-up data show that a large percentage of compression fractures of the lateral tibial condyle in which reposition has not been effected lead to invalidism, due to arthrosis. Reduction of these fractures can only be done operatively and its accuracy can only be determined

through an open joint. Intra-articular complications—usually lesions of the lateral meniscus—are common, which is a further indication for arthrotomy.

However, fixation of the scattered spongy fragments of the articular surface of the condyle is attended with a special difficulty. The writer describes a simple and conservative operative method, which makes possible reposition as well as retention of the fragments without extensive exposure of the tibial condyle. The operation has been performed successfully in fourteen cases, eight of which have been followed up for more than one year after the injury.

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# THE PATHOLOGY OF UNUNITED FRACTURES OF THE NECK OF THE FEMUR WITH SPECIAL REFERENCE TO THE HEAD<sup>\*</sup>

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Ununited fractures of the neck of the femur are distinctive for their relative frequency and resistance to successful operative treatment. These in turn are dependent in large degree on structural peculiarities of the hip, fractures of which result in pathology that is not ordinarily seen in fractures of other parts of the skeleton. These peculiarities are: (1) the approximately 125-degree angle of the neck to the shaft, resulting in marked shearing and erosion of the neck fragments; (2) the absence of a cambium layer in the fibrous covering of the neck with no peripheral callus formation in the healing process; and (3) most important, the variable arrangement of the blood supply of the head, which, in case it is derived from neck vessels, may be cut off by the fracture with resultant necrosis of the head fragment.

The author has been asked to discuss the pathology of ununited fractures of the neck of the femur with special reference to the head in terms of three questions. The first question is: "By what signs in the roentgenogram do you determine whether the head is viable or alive?" A viable head with non-union may usually be determined in roentgenograms



FIG. 1

Case 1. Non-union of three months' duration. Density uniformly reduced in head, shaft, and adjacent pelvis, indicating a viable atrophic head.



FIG. 2

Case 1. Three and one-half years later, showing restoration of density, newly aligned trabeculae, intact joint surfaces, and normal contour of head.

<sup>\*</sup> Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 19, 1939.

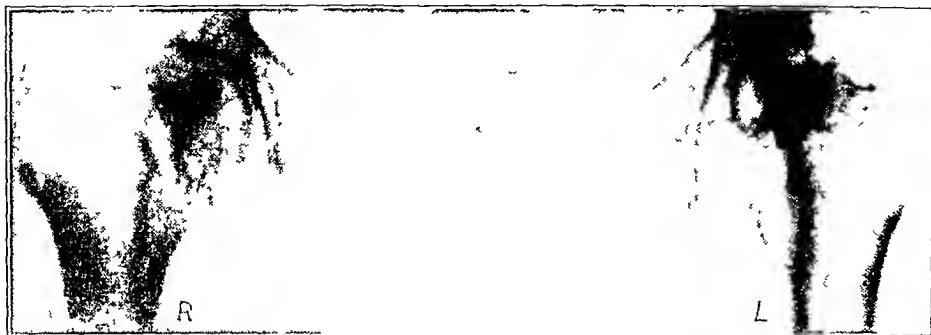


FIG. 3

Case 2. Bilateral intracapsular fracture of the hip. The right hip, fractured seven and one-half years before admission, shows bony union and an intact head and joint, indicating a viable head. The left hip, fractured three and one-half years before admission, shows bony union, but the top of the head has collapsed and the joint is disrupted, indicating a necrotic head.

by the presence of disuse atrophy, giving even reduction in density, about equal in all portions of the head, upper end of the shaft, and the adjacent pelvis. These density changes are usually present by the time that the evidences of non-union can be made out and they usually last as long as the fracture remains ununited. In case of long-standing non-union, the articular surface of the head retains its normal contour, and the cartilage space and articular cortices remain intact. If an operation is performed, resulting in bony union, and if function is restored, the bone again increases in density. Union following an operation is more common than in the case of a necrotic head. Subsequent collapse of its weight-bearing portion does not take place and the functional result is usually a good one. This is illustrated by Case 1.

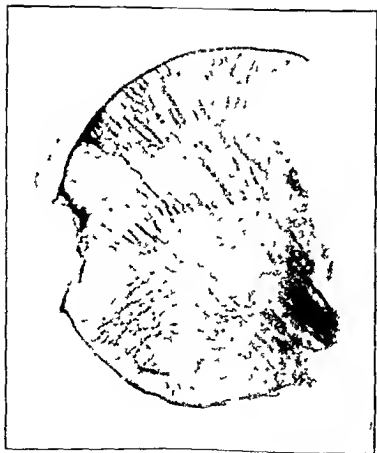


FIG. 4

Roentgenogram of slice of dead head excised five and one-half months after fracture, with non-union. The superior and lateral portions consisted of old dead bone of original density; the inferior and mesial portions consisted of spongy new bone, which replaced the old.

This patient was a woman, fifty-seven years old, who had an ununited fracture of three months' standing (Fig. 1). The even uniform regional reduction in density indicates a viable head. It was treated by open reduction, curettage of fracture surfaces, and fixation with a tibial bone peg. There was bony union after twelve weeks of cast immobilization. Three and one-half years later there was almost complete restoration of function without pain, and the roentgenogram (Fig. 2) shows the density of the bone restored and the articular cortices and the cartilage space of the joint unchanged. Their behavior is similar to that of a viable head in case of fracture of the neck treated by non-operative measures with primary

bony union and is in marked contrast with the result often seen in the case of a necrotic head with primary bony union, where early weight-bearing may result in collapse of the dead head before it has had time for invasion and rejuvenation. Case 2, that of a female, aged seventy-five years, illustrates both of these types of fracture. Seven and one-half years before admission, the neck of the right femur had been broken, and bony union followed three months of treatment by rest in bed. Function was gradually restored almost to normal in the course of nine months, and the hip has remained freely mobile and painless since then. Four years later the patient suffered the same injury of the left hip, which was treated in a body-and-leg cast for four and one-half months with resultant bony union. She then resumed walking, but the left hip remained somewhat painful and stiff, and the condition gradually became worse, so that after two years she could walk but little.

Figure 3 shows the fracture of the right hip to be united with shortening of the neck, but the head has preserved its normal contour and the articular cortices and the cartilage space of the joint are of normal appearance. In contrast, the left hip shows union of the fracture, but marked collapse of the head and irregularity of the joint surfaces. Evidently the blood supply of the head of the femur was preserved on the right side, but was destroyed on the left side, with resultant necrosis and collapse of the head before there was time for creeping replacement of the necrotic bone.

When the head dies following the fracture, and non-union results, there is atrophy of disuse of the living bone of the shaft and the pelvis, while the dead bone in the head retains its original density. Consequently, after two or three months, it may be seen to cast a denser shadow in roentgenograms than the surrounding living bone. However, invasion of the marrow spaces of the dead head soon begins by blood vessels and fibrous tissue through the round ligament, untorn portions of capsule, and later through adhesions. As this invasion proceeds, it is followed by creeping substitution of the dead bone and fibrous marrow by a less dense living bone and hemopoietic marrow. The lower and mesial portions of the head are usually invaded and transformed first. The process extends upward and outward from the fovea and lower portions at an extremely variable rate. Usually in the course of a few months the

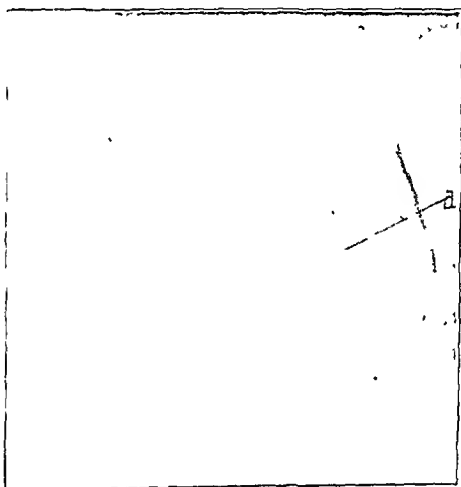


FIG. 5

Case 3. Non-union of nineteen months' duration. The mesial and superior portions of the head (a) are untransformed and denser than the lateral and inferior portions, which have been replaced by new bone.





FIG. 6

Case 3. Excised head, showing intra-articular adhesions.

transformed lower and mesial portions of the head may be distinguished in roentgenograms by their marked reduction in density in contrast to the rest of the head, which has preserved its original density. This is illustrated in Figure 4, a roentgenogram of a slice of the head of a femur excised five and one-half months after the fracture in an arthrodesing operation, which was performed because of non-union. The superior and lateral portions consist of the old dead bone of original density, while the inferior and mesial portions consist of much less dense living bone which had replaced the old. The portions of the dead bone farthest from the living were still uninvaded by fibrous tissue, while the cancellous spaces of that bordering on the new bone were filled with fibrous tissue. The articular cartilage over the dead bone stained very faintly, while that over the living bone stained normally. Apparently the cartilage over the dead bone was in a low state of nutrition, which was preserved only by penetrating synovial fluid. That over the renovated areas had had its main source of nutrition restored from beneath and had resumed normal staining properties.

Creeping replacement of the dead portion by living bone may gradually progress, and in from one and one-half to three years it may be complete. If the new bone does not reach the under surface of the articular cartilage within several months, it usually becomes completely necrotic and is subsequently gradually invaded and replaced by fibrous tissue, fibrocartilage, or even bone. The rate of replacement may usually be followed in roentgenograms because of the density differences between the necrotic and the renovated areas. This is illustrated in Case 3, that of a male, thirty-nine years old, who had an ununited fracture of nineteen months' duration. Figure 5 shows a new-moon-shaped region of greater density along the articular surface above the fovea and in a small region below it. The

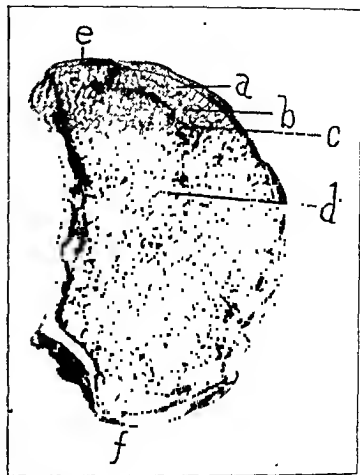


FIG. 7

Case 3. Microscopic section of head, showing uninvaded dead bone and dead marrow (a); dead bone invaded by fibrous marrow (b); zone of replacement of dead by living bone (c); spongy new bone (d); old cartilage replaced by fibrocartilage (e) and by bone (f).

extensively adherent head (Fig. 6) was excised by Dr. Compere in a Whitman reconstruction operation. A microscopic section made coronally through the head (Fig. 7) shows the old dense area along the articular surface, much larger above than below the fovea, while the rest of the head is composed of finely trabeculated new bone. The old bone immediately beneath the articular cartilage consists of uninvaded dead bone and dead marrow. Next to this is a zone of dead bone invaded by fibrous tissue, and adjacent to this is the zone of transformation into living bone. The old cartilage over the dead bone is necrotic and in places has been replaced along the surface by overgrowing fibrous tissue. At the superior and lateral portion of the head the old cartilage has been replaced by fibrocartilage. Old articular cortex is intact in the dead regions and is denser than the uneven new articular cortex in the replaced regions. The dead articular cartilage of the lower portion has been invaded in places and replaced by cancellous bone. A cortex has formed along the surface where the neck was eroded.

Necrotic heads that have been completely replaced by new bone may be extremely porous with irregular articular surfaces and are usually bound to the acetabulum by extensive adhesions. They may be recognized in roentgenograms by their porous nature and blurred, uneven shadows of articular cortices. This is illustrated by Case 4, that of a

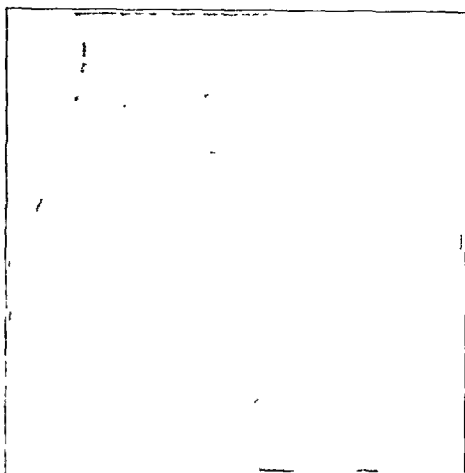


FIG. 8

Case 4. Eight years after fracture. The head is full of cavities and the articular surfaces are hazy, indicating an imperfectly renovated dead head.



FIG. 9

Case 4. Section of head excised at autopsy fourteen years after fracture.

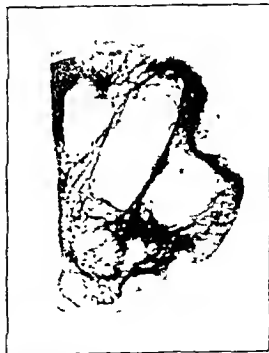


FIG. 10

Case 4. Roentgenogram of slice of excised head.

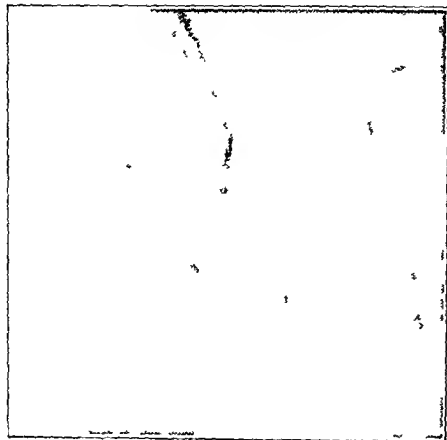


FIG 11

Case 5 Eleven months after fracture The head throughout is denser than the surrounding atrophic bone, indicative of necrosis without substitution



FIG 12

Case 5 Three and three-quarters years after fracture The superior and lateral portions of the head are dense The shadow of the articular cortex in the mesial and inferior portions is hazy or lost, and the underlying bone is reduced in density, indicative of substitution in that region

female who fractured the left hip at the age of forty-nine years.

Figure 8 is a roentgenogram taken eight years later The patient died fourteen years after the fracture, and Figure 9 shows the excised and sectioned ununited head, which was markedly adherent to the acetabulum. It was little more than a partitioned hull, as is shown in Figure 10, which is a roentgenogram of a slice cut from the middle portion. The articular cartilage had been replaced by fibrocartilage in its superior portion and elsewhere by fibrous tissue



FIG 13

Case 5. Photograph of excised head, loose bodies, and villous synovial lining.

Microscopically all of the old bone had been replaced by new bone, and the pockets within were filled with fatty marrow. Such a head is unsuited for any type of operation intended to produce bony union of the fracture. In connection with the organization of the dead articular cartilage, a moderate arthritis deformans may be established, characterized by villous synovitis and osteo-cartilaginous loose bodies in the joint



FIG. 14

Case 5. Coronal section of head consists of old dead bone and cartilage except along ragged articular surface mesially and below where replaced by new bone.



FIG. 15

Case 5. Roentgenogram of slice of head. New bone along mesial and inferior margins reduced in density (a); remaining bone dead and of original density.

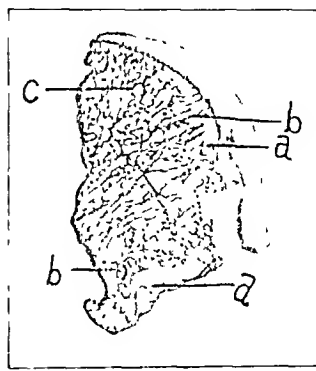


FIG. 16

Case 5. Microscopic section of head, showing zone of replacing new spongy bone (a-a); zone of dead bone invaded by fibrous tissue (b-b); and uninvaded dead bone and dead marrow (c), with overlying dead cartilage.

In some cases the dead head is very slowly invaded by fibrous tissue, and there is little replacement of the invading dead bone by new bone and hemopoietic marrow. It is difficult to understand why replacement takes place rapidly in some cases and very slowly in others. Tardy replacement is illustrated by Case 5, that of a female, aged seventy-two, who fractured the neck of the femur eleven months before admission. Figure 11 is a roentgenogram of the hip eleven months after injury, in which the entire head casts a denser shadow than the adjacent living bone of the shaft and the pelvis. A second roentgenogram, Figure 12, taken three years and nine months after injury, shows the lateral and superior parts of the head and the superior articular cortex to be of approximately the same density as shown in Figure 11. The mesial and inferior articular cortex and a narrow strip of the underlying bone are hazy and reduced in density. The head was excised, and a Whitman reconstruction operation was performed. It was extensively adherent to the acetabulum. The synovial-membrane lining showed a marked villous arthritis, and there were three osteocartilaginous loose bodies in the joint. Figure 13 is a photograph of the mesial surface of the head, the loose bodies, and a portion of the villous lining. Figure 14 shows the cut surface of a coronal section of the head; Figure 15 is a roentgenogram of a slice of the head; and Figure 16 is a microscopic section of the same. They show that the head had become necrotic as a result of the fracture. It had been invaded by a fibrous tissue from the round ligament at the fovea and from adhesions along the lower portion in almost one-half the extent of the head, but only a narrow strip about the fovea and along the surface of the inferior portion had been replaced by new bone and marrow, as shown in Figure 16. Bone and cartilage at the top of the head were dead and uninvaded. The process of invasion and

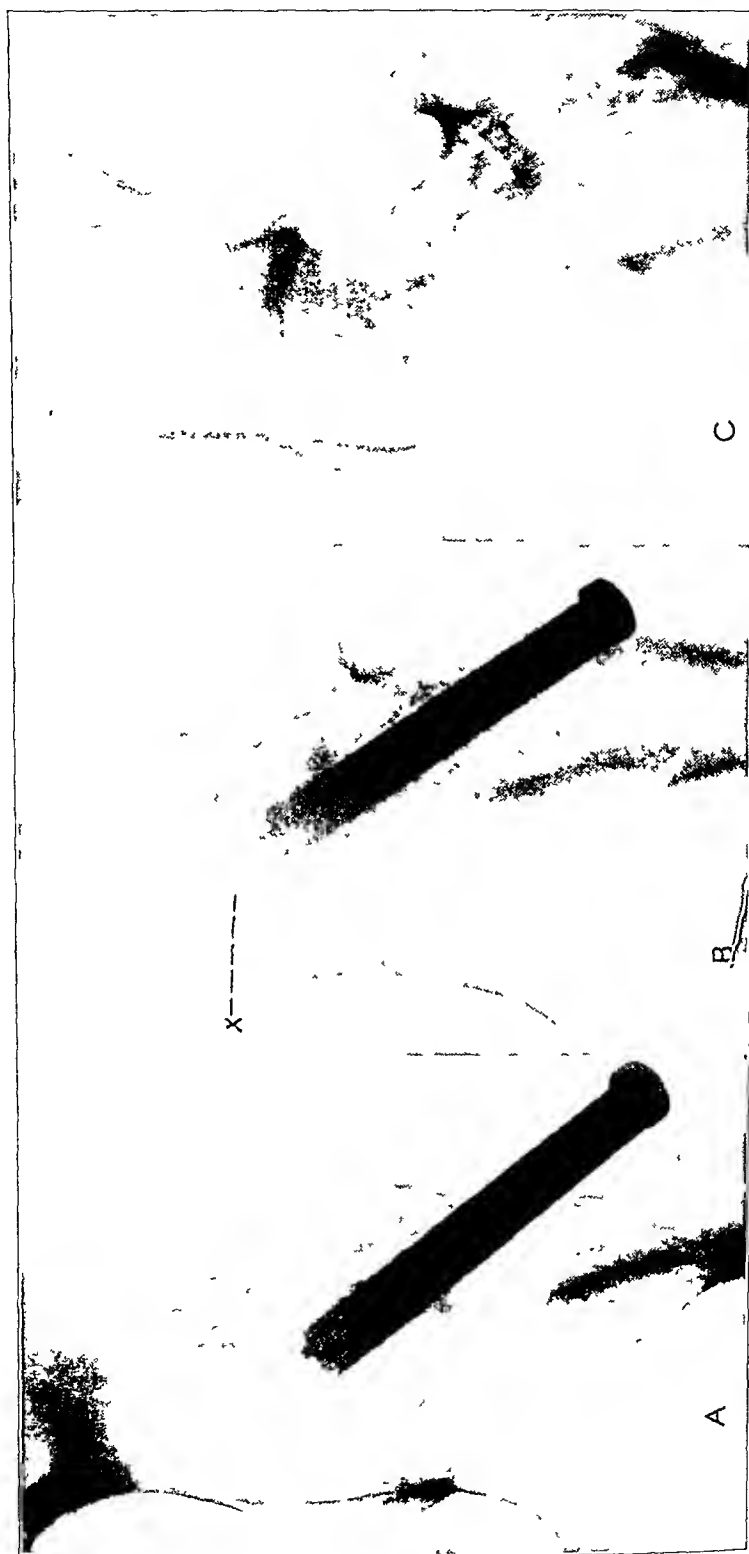


Fig. 17-A

Case 6. Three months after nailing for non-union of two months' standing.

Fig. 17-B

Case 6. Fifteen months after operation. Head transformed except for collapsed necrotic area (x).

Fig. 17-C

Case 6. Six years after operation. Head completely transformed.

creeping replacement appeared to be practically at a standstill and most of the head would probably have still consisted of dead bone had several years more elapsed before its excision. In another case, in which replacement had apparently come to a standstill four and one-half years after the fracture, there was in places calcification of the fibrous marrow about the limits of the uninvaded dead bone. Such an untransformed head is also unsuited for an operation designed to obtain bony union.

The second question is: "Do you consider it possible to restore sufficient blood supply to a devitalized head to warrant saving it?" It has just been noted that, in some cases of ununited fracture of two or three years' duration, the dead head will be revascularized and extensively or entirely transformed into new bone and the dead articular cartilage will be replaced by fibrocartilage. It would seem reasonable that, if bony union could be obtained in such cases, the head would be worth saving. The only way in which the surgeon may help to restore circulation to a devitalized head in the case of ununited fracture is by an operation which results in bony union. The untransformed portion of the dead head may then be invaded by blood vessels and fibrous tissue, which cross the healed fracture, and transformation may then proceed more effectively than in the case of non-union. This is not only because of the greater ease of invasion, but also because of greater functional stimulation following the occurrence of bony union. The situation then becomes somewhat analogous to that of a fresh fracture with death of the head, which has been treated with or without operation, with resultant bony union. Such a dead head may collapse from too much weight-bearing before it is invaded and transformed, as was shown in Figure 2, and the same may be true if operation has resulted in bony union of an ununited fracture with death of the head. If replacement comes about with little or no collapse of the head, the functional result may be a reasonably satisfactory one. For this reason, weight-bearing should be avoided for many months after bony union has taken place in cases of fracture of the neck with death of the head, whether the union is primary or secondary to an operation. Bony union and a good result following operation for non-union with necrosis of the head are illustrated by Case 6.

The patient in Case 6 was a female, fourteen years old, who had non-union two months following the fracture. The fracture was reduced and the fragments were fixed with a Smith-Petersen nail. Three months later, there was bony union (Fig. 17-A) and the head fragment possessed its original density except for some irregularity in the neck. After five months, the patient was allowed to walk on the limb. Following this there developed gradually a mottled density in the head, and there was slight caving in of a small portion of cortex in line with the nail, which was evidence of necrosis of the head. Fifteen months after operation (Fig. 17-B), the head appeared to be entirely transformed with the exception of the small caved-in portion. The pin was then removed. Function had returned to normal, and the hip was painless. Six years after the

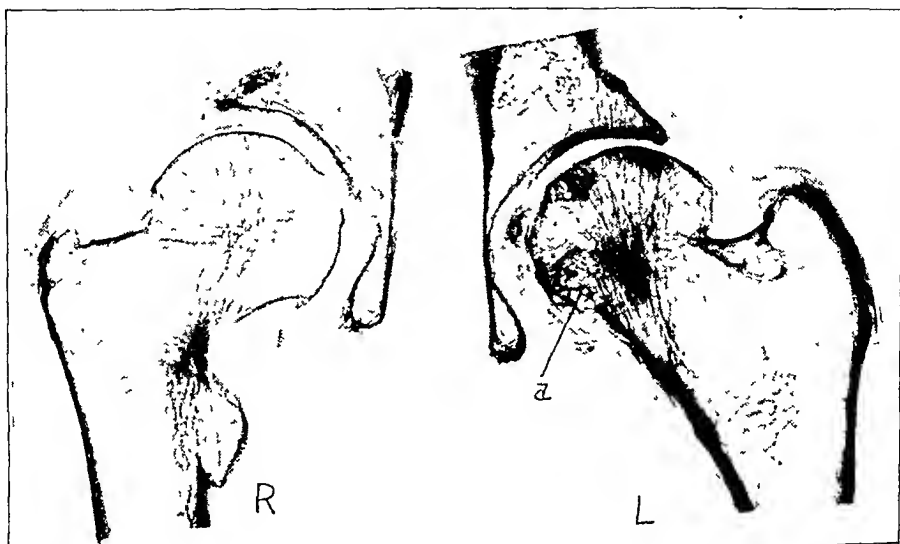


FIG. 18

Case 7. Roentgenograms of slices of hips. Intracapsular fracture of right hip at base three and one-half years previously; the fragments have united, the head is alive, and the joint is unchanged. Intracapsular fracture of left hip eight years previously; the fragments have united, the head was devitalized but now has been replaced by new bone except the partly calcified area (a), and the joint shows arthritis deformans with shadows of loose bodies.

operation, the roentgenograms (Fig. 17-C) showed the small sequestered collapsed area to have been replaced by new bone. There were then no signs of a deforming arthritis, but arthritis deformans is likely to develop in the future. In another case it did not set in until ten years after healing of the fracture with death of the head; then, in the course of eight years, it became of severe grade.

That an acceptable functional result may follow fracture of the neck with death of the head and bony union in the aged is illustrated by the following case which came to autopsy. In Case 7, the patient, a female, aged ninety-six years, sustained an impacted intracapsular fracture of the neck of the left femur, which healed with bed rest, but she did not bear weight on the limb for more than one year. Function then returned to normal, and she walked without pain for four years, when



FIG. 19

Case 7. Photograph of slice of left hip, showing arthritis deformans, loose bodies, and transformation of head with exception of calcified necrotic area (a).

the right hip was fractured at the base of the neck. She then remained bed-ridden until death four years later at the age of 104. At autopsy both hips were obtained. The right hip showed normal findings aside from the angulated neck of the femur, which had been fractured at its base. The left hip showed moderate deforming arthritis with osteocartilaginous loose bodies and roughened irregular thinning of the weight-bearing articular surfaces. Figure 18 is a roentgenogram of slices of both hips. A section of the upper end of the left femur and acetabulum is shown in Figure 19. Its articular cartilage was roughened and thinned in the weight-bearing portions, and two of the loose bodies were attached by narrow pedicles to the round ligament. There was a circumscribed yellowish-gray area, one and five-tenths centimeters in diameter, in the inferomesial part of the head. Microscopic examination showed it to be a necrotic area, which was surrounded by a fibrous zone that was extensively calcified in its inner portion. There was old articular cartilage at the superolateral and inferomesial portions of the head, which was dead and partly calcified and ossified, and small marginal osteophytes were present. In the weight-bearing portion of the head, the articular cartilage was replaced by fibrous tissue and fibrocartilage, and there was a small area of old dead bone beneath the old dead articular cartilage in the superolateral region. The rest of the head had been replaced by new bone. The findings showed that the head had become necrotic as a result of the fracture, and that all the dead bone had been replaced by new bone except the two islands mentioned. The cartilage had died and had been partly replaced by fibrocartilage in the weight-bearing regions, and secondary to the cartilage necrosis there developed a deforming arthritis similar to that reported by Axhausen in both human and experimental arthritis deformans. The diagnosis of such changes by roentgenograms is difficult, because the density differences which exist between the dead bone and the replacing new bone, seen in cases of dead head with non-union, are not present here. The new bone which replaces the old in the presence of active function is usually of as great density as the old bone. However, the calcified periphery of the necrotic area, the irregular trabeculae, and the evidences of arthritis deformans with loose bodies are shown in the roentgenogram (Fig. 18), in contrast with the right hip where the head remained viable, and are diagnostic.

It has been claimed that a bone graft inserted across the fracture line serves to conduct blood vessels from the distal fragment into the dead head, but, since the graft consists of compact bone, the number of vessels reaching the head by growth through it is insignificant as compared with the number of those which grow directly across the fracture line through the cancellous bone uniting the fracture. Consequently, the bone graft as a conductor of blood vessels is of no importance, although, as an agent for fixation of the fracture and as a bridge for new bone, it may function effectively in procuring bony union.

The third question is: "In the light of the studies of the pathology



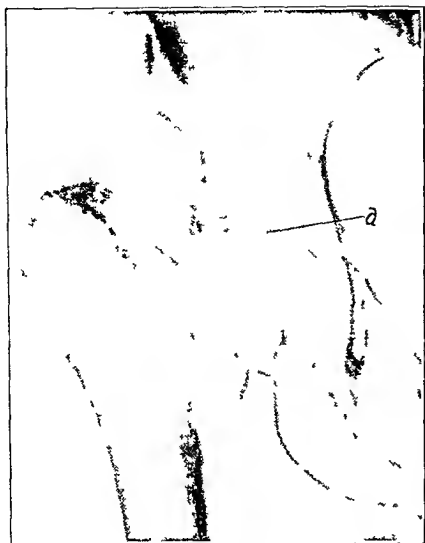


FIG. 20

Case 8 Nineteen months after fracture with non-union. The necrotic head has been replaced by spongy new bone except at *a*.



FIG. 21

Case 8 Bony union twenty months after insertion of two bone pegs. Necrotic area at top has been absorbed.

of the femora which you have made, what types of operation do you believe are indicated for this condition?" This is an embarrassing question and will be answered only in a very general way with the assumption that there are no special contra-indications to operation. In the case of an ununited fracture of the neck of any duration, in which the head is viable, an operation should be performed in an attempt to obtain bony union. Union is much more likely to follow operation if the head is alive than if it is dead. In the case of an ununited fracture with a necrotic head and any degree of replacement by new bone, if seen relatively early, an operation should be performed in an attempt to obtain bony union. If union follows operation, the result will usually be preferable to non-union or to that following any other type of reconstructive operation. The limb should then be protected from weight-bearing for six months or more, depending on the rate of replacement of dead bone by new bone as judged by roentgenograms.

If the patient is seen late—that is, from two to three or more years after fracture, when the dead head is unreplaced or has been converted into a fragile hull with loss of shadow of articular cortex, indicative of transformation of the head and adhesions in the joint—it is best to perform either a Whitman reconstruction operation or an arthrodesis. It would be difficult to discuss in limited space the many methods which have been successfully used for obtaining bony union in the cases to which reference has been made. In general, freshening of fracture surfaces, accurate approximation, and good fixation are the important essentials. Autogenous pegs serve for fixation and help to establish a bone bridge. How-

ever, Putti and McMurray have shown that intertrochanteric osteotomy with mesial displacement of the distal fragment, without interference with the fracture line, results not only in union of the osteotomy and improved weight-bearing, but also in bony union of the fracture in a considerable percentage of the cases. One of the most successful procedures that has been employed in our Clinic is that used especially by Dr. Compere. It consists in open reduction of the fracture, curettage and apposition of fragments, insertion of one or two tibial bone pegs, and further fixation by the insertion of three threaded wires placed at slightly different angles, but directed as obliquely upward as possible in order to relieve the neck of shearing force.

Figure 20, Case S, is an illustration of successful union obtained by bone pegging nineteen months after fracture, when the necrotic head had been replaced by new bone except for a small dense area in its superior portion. Figure 21 shows the result twenty months after operation. The remaining necrotic area had been absorbed with little replacement of the defect by new bone, but a satisfactory functional result was obtained.

# THE AUTOGENOUS BONE GRAFT \*

BY WILLIS C. CAMPBELL, M.D., MEMPHIS, TENNESSEE

## INDICATIONS FOR BONE GRAFT

The type of case in which the autogenous bone graft is indicated depends upon several factors: (1) status of the structure of the bone about the fracture site; (2) length of time since fracture; (3) age; (4) economic status; (5) physical status.

1. The structure of the neck depends entirely upon atrophic changes in the distal fragment, as indicated by the extent of absorption of the neck; therefore, the best results are secured in those cases in which the neck has remained normal without extreme upward displacement. Excellent results are possible, however, even after extensive absorption has taken place, but the percentage of good results is not as high as in those cases in which the neck has remained intact. The absorption of bone is almost entirely from the distal fragment, as this is composed largely of cancellous bone in which the action of osteoporosis is more definite and extensive; also, at this location there is excellent circulation, which is necessary for atrophic changes. Atrophic changes in the head of the femur are very slow, because of the facts that the blood supply after a complete central fracture is always impaired, and the structure of the normal bone in the head is exceedingly dense.

2. The length of time which has elapsed since operation does not necessarily determine the indication for operation, but the most favorable time to secure the highest percentage of excellent results is just as soon as the status of non-union has been reached. In the past, it was the author's belief that, when a central fracture of the neck of the femur had remained ununited for a period of three to six weeks, it should be regarded as ununited, and that there was no such state as "delayed union". However, since the introduction of internal fixation, he has been able to secure successful results after a longer period than formerly, so that possibly the status of non-union in this fracture may not be reached until the lapse of from two to three months. Very rarely, however, is an ununited fracture of the neck of the femur presented for treatment until the lapse of at least six months, and in many instances treatment is delayed for one or more years. Solid union has been secured by Zadek and others by the Whitman method after the lapse of three months, but, in the light of more recent knowledge, such results would be very seldom secured. In some instances, the neck of the femur may remain practically intact for a long period of time, as may be determined by roentgenograms with the hip in internal and external rotation, and by lateral views, but, after the lapse

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 19, 1939.

of one year, the chances of success decrease rapidly because of atrophic changes in structure, even though the neck is preserved.

Autogenous bone grafts have been employed with internal metallic fixation, but the author has had no experience with this procedure.

3. The age of the individual must be considered in a general way, for the older the patient, the more difficulty will be encountered by long confinement. The reaction of bones and other tissues to age is not in accordance with the number of years, but is a question of the individual case, which depends upon many factors, such as congenital status and general bodily care of the individual,—in other words, wear and tear. In consequence, no arbitrary age can be given, but in general sixty-five should be the upper limit, although excellent results have been secured in much older patients.

4. Due consideration must also be given to the economic status and occupation, as a much longer time is required to secure union—at least six months and in some cases much longer—so that the total disability is usually about one year or longer. The decision must often be made in suitable cases between the graft, the subtrochanteric osteotomy, or reconstruction operations in which the total period of disability is much shorter, even though there will often be more permanent disability.

5. The patient must be in good physical condition, as the operation is a major surgical procedure.

The factors which render the patient unsuitable for operation are as follows: (1) poor physical condition; (2) advanced age; (3) complete absorption of the neck; (4) an unusually short proximal fragment; (5) extreme upward displacement of the distal fragment with absorption of the neck; and (6) excessive atrophy of structures without absorption of the neck.

#### “BLIND PEGGING” VERSUS OPEN OPERATION

The author has not had sufficient experience with “blind pegging” to evaluate the method. Prior to the advent of other measures, such as osteotomy and reconstruction, the author had used this type of operation in a small number of cases in which the physical status contra-indicated a more extensive procedure. It is the author’s belief that the best results can be secured by wide exposure, excision of the pseudarthrosis, and approximation of the raw osseous surfaces.

#### TYPES OF GRAFT

Either an autogenous graft from the anterior surface of the tibia, about one-half an inch in width, or the grafting of the entire shaft of the fibula from the upper third well below the peroneal nerve may be considered. The fibula has the advantage of being much stronger. The author has used both, but the tibia is employed more frequently, because of the osteogenic endosteum, and also because of the advantage of securing curettements of cavernous bone from the upper extremity of the tibia to be inserted into the line of fracture.

The joint is approached by the anterior iliofemoral incision in which the lower extremity is curved backward over the trochanter. Dissection is made between the sartorius and the tensor fasciae latae to the line of fracture, and by reflecting the vastus lateralis at the trochanter. The fracture site is denuded and approximated, after which a large Kirschner wire is inserted and two-view roentgenograms are made by which the relationship of the fragments and the position of the wire are determined. If the fibula is used, it is inserted over wire, as in the Johansson method of inserting a nail; if the tibia is employed, the graft is driven in parallel with the wire. In either event, a two-view roentgenogram is made to be certain that both fragments are transfixed and the osseous surfaces are closely approximated. In the earlier cases two incisions were used, and later the Kocher U incision, but the technique described is employed at the present time.

#### POSTOPERATIVE FIXATION

A cast is applied from the nipple line to the toes on the affected side and to the knee on the normal side. This is changed at the end of two months, because of looseness of the cast. At the end of three months an abduction hip brace with a Thomas ring, and with hinges at the knee but not at the hip, is employed. Walking on crutches with the brace is permitted in from four to six months, usually nearer six months. The brace is then cut down to a Thomas knee brace with a perineal ring, and weight is gradually increased.

#### WEIGHT-BEARING

No weight is borne until the new lines of pressure and stress passing across the fracture site can be demonstrated by the roentgenogram. This is observed in from six to nine months. Weight is then gradually increased. Roentgenograms should be taken about every thirty to sixty days, and, if there is the slightest change in relation of the fragments, weight-bearing is discontinued.

#### END RESULTS

In 1919 an analysis of the end results in twenty cases was made: fourteen showed excellent results with osseous union; four had been treated too recently to warrant any conclusions; and two were failures. At that time, the criteria of determining osseous union were by no means as efficient as at present; therefore, this series is excluded. Since 1919 there have been forty cases in which the procedure has been employed, making a total of sixty cases, but approximately only the forty cases since 1919 form the basis of this discussion. In only thirty-four of these could the end results be determined; osseous union was obtained in twenty-one; questionable union, in two; and non-union, in eleven. Of the twenty-one patients (61.7 per cent.) in whom osseous union was unquestionably



FIG. 2

Bone graft in 1932 after extensive absorption of the neck. Result seven years later, coxa vara deformity, slight, if any, limp, and no pain.



FIG. 1

Bone graft in 1930. Normal neck. Perfect result nine years later. The transplant has entirely disappeared.

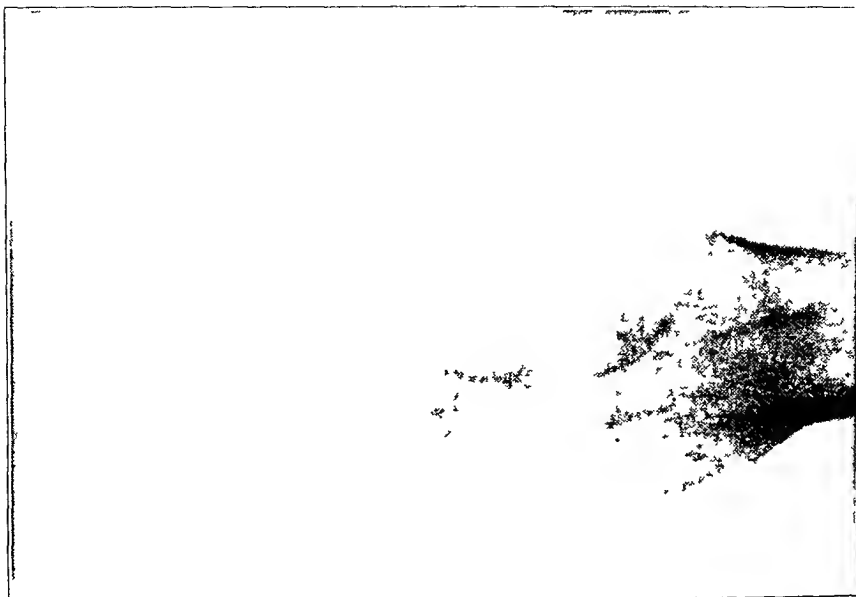


Fig. 4

Brackett type of operation with bone graft between fragments, in 1929. Result nine years later, excellent with no pain or limp.



Fig 3

Bone graft in 1929. There was partial absorption of the neck. Result excellent after ten years, though excessive coxa vara, slight limp, but no pain.

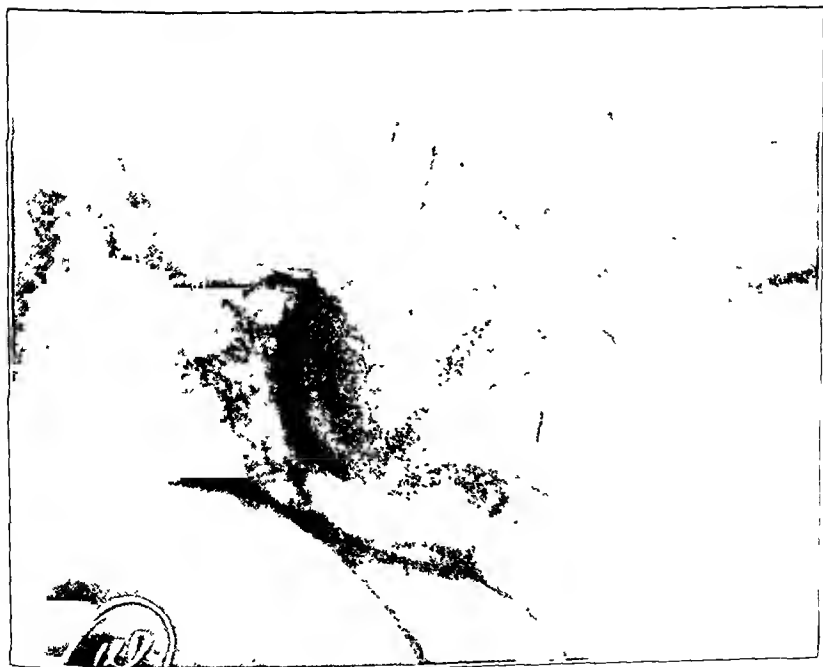


FIG. 5

Bone graft in 1917. Result twenty-one years later, practically normal range of motion.



FIG. 6

Bone graft in 1924. Result fifteen years later, excellent with late flattening of head, slight limp, but no pain.



obtained, thirteen (61.9 per cent.) had a limp, but usually a perfectly satisfactory hip, with the exception of two patients who required some type of support; each of the eleven remaining patients had a much more stable hip and less limp than is usually observed after reconstruction operations. Eight, or 38.1 per cent., walked practically normally. There was no pain in nineteen cases (90.5 per cent.), while there was considerable pain in two cases (9.5 per cent.), in one of which there was a generalized arthritis and in the other a subtrochanteric osteotomy was performed at the time when the graft was inserted. These two cases were the ones in which support was required. Eighteen patients (85.7 per cent.) were able to lace their shoes and had a practical range of motion; three (14.3 per cent.) did not.

Of the twenty-one cases, flattening of the head was noted in five, while in the remainder the head remained practically normal, but in these there was slight decrease in joint space when compared with the normal hip.

Of the twenty-one cases in which bony union was obtained, the results were excellent in sixteen (76.2 per cent.), good or fair in three (14.3 per cent.), and poor in two (9.5 per cent.).

Of two cases in which there was questionable or weak union, function and endurance were good in one and poor in the other. Of eleven cases in which no union was secured, good functional results, with a reasonable degree of endurance, were obtained in three and support was not required.

In the sixty cases in which the operation was employed, there was only one operative death (1.7 per cent.).

#### CONCLUSIONS

The procedure is undoubtedly less frequently indicated or employed than in the past, since other measures have been devised which require a shorter period of confinement; also, since the general use of internal fixation, the percentage of bony union in fresh fractures has been materially increased. However, in young and middle-aged vigorous individuals, before there is absorption of the neck, a better functional result can be secured by the bone graft than by any other method which has been evaluated at the present time.

# THE COLONNA RECONSTRUCTION OPERATION FOR UNUNITED FRACTURES OF THE NECK OF THE FEMUR \*

## ANALYSIS OF SEVENTY CASES

BY PAUL C. COLONNA, M.D., OKLAHOMA CITY, OKLAHOMA

*Professor of Orthopaedic Surgery, Oklahoma University School of Medicine, Oklahoma City*

In order to evaluate the type of reconstruction operation devised in 1931 to restore skeletal support, a letter was sent to 128 orthopaedic surgeons inquiring if this procedure had been done in their clinics, and, if so, the number of cases in which it had been used. This inquiry brought out the fact that this type of reconstruction operation for ununited fractures of the neck of the femur had been done in 121 cases.

Questionnaires were then sent, and it is through the cooperation and kindness of the various orthopaedic surgeons throughout the country that the author has been able to make this analytical review of the seventy cases reported by twenty-two operators. Many of these questionnaires were not complete in every detail, but enough data were obtained for a critical analysis. In classifying the end results, the author has considered the cases with reference to: (1) surgery performed previous to the reconstruction operation; (2) preoperative evidence of arthritis. In the first group, there were forty-two cases in which no surgery had been performed upon the hip joint before the reconstruction operation and thirteen cases in which the reconstruction operation was preceded by some type of internal fixation at the time of the original fracture; in the second group, there were ten cases in which some degree of arthritis was noted prior to operation and thirty-eight cases in which no arthritis was observed. There were thirty-nine cases with complete absorption of the neck and fifteen cases with incomplete absorption. From the fully completed questionnaires, the end results in forty cases have been evaluated on the basis of pain, stability, capacity for work, and range of motion recorded at least one year and, in many instances, three or more years after the reconstruction operation. These questionnaires also brought out the fact that, while one operator stated that the procedure had been done in twenty-five minutes and another said that it required three and one-half hours, the average time reported for the reconstruction operation was one hour and twenty minutes, which is a little longer than has usually been required in our hands. Seventy per cent. of the total number of patients were between fifty and seventy years of age.

We have previously stated that in the patient with frank non-union, accompanied by complete neck absorption and head necrosis, any attempt at pegging, either with bone or metal, is apt to result in failure. It is felt that in the advanced type, which is usually accompanied by severe dis-

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 19, 1939.

TABLE I

COMPARISON OF FINDINGS IN CASES WITH SURGERY PREVIOUS TO RECONSTRUCTION OPERATION WITH THOSE IN CASES WITHOUT SUCH SURGERY \*

Type of Case	Preoperative Data		Postoperative Data								
	Absorption of Neck	Necrosis of Head	Flexion in Degrees	Work	Pain		Stability	Walking		Average Gain in Length after Operation	Results
					Degree	Before After		Before After			
Surgery Previous to Reconstruction Operation—13 Cases	Complete	5 Yes	5 0-20	2 Usual	2 Moderate	3 2	12 Yes	4 2	6 6	0.68 inches	Excellent 2
	Incomplete	7 No	6 20-40	0 Part	3 Severe	8 2	No	1 Cane	2 5		Fair 8
	Not stated	1 Not stated	2 40+	8 None	5 None	1 7	Not stated	0 Brace	0 0		Poor 2
			Not stated	3 Not stated	3 Not stated	1 2		Without support	0 1		Failure 1
No Surgery Previous to Reconstruction Operation—42 Cases †	Complete	34 Yes	19 0-20	0 Usual	24 Moderate	15 11	Yes	38 Crutch	20 3	0.76 inches	Excellent 25
	Incomplete	4 No	11 20-40	8 Part	7 Severe	19 0	No	2 Cane	2 15		Fair 11
	Not stated	4 Not stated	12 40+	28 None	1 None	7 28	Not stated	1 Brace	3 0		Poor 4
			Not stated	5 Not stated	9 Not stated	0 2		With support	4 0		Failure 1
								Without support	2 21		Not stated 0
								Unable	9 0		
								Not stated	1 2		

\* Based on operators' reports one or more years after operation.

† One patient died suddenly on the nineteenth day; consequently there are no postoperative data on this case.

TABLE II

COMPARISON OF FINDINGS IN CASES WITH PREOPERATIVE EVIDENCE OF ARTHRITIS WITH THOSE IN CASES WITHOUT SUCH EVIDENCE \*

Type of Case	Preoperative Data		Postoperative Data								Results
	Absorption of Neck	Neerosis of Head	Flexion in Degrees	Work	Pain		Stability	Walking		Average Gain in Length after Operation	
					Degree	Before		After	Before		
Preoperative Evidence of Arthritis—10 Cases	Complete	6 Yes	4 0-20	1 Usual	2 Moderate	2 2	2 Yes	9 Crutch	2 2	0.75 inches	Excellent 3
	Incomplete	4 No	2 20-40	2 Part	2 Severe	5 2	2 No	1 Cane	2 3		Fair 4
	Not stated	0 Not stated	4 40+	4 None	2 None	3 5	Not stated	0 Brace	1 0		Poor 3
			Not stated	3 Not stated	4 Not stated	0 1		With support	1 0		Failure 0
No Preoperative Evidence of Arthritis—38 Cases	Complete	27 Yes	18 0-20	2 Usual	22 Moderate	3 9	2 Yes	35 Crutch	21 7	0 77 inches	Excellent 19
	Incomplete	9 No	15 20-40	5 Part	7 Severe	30 2	2 No	2 Cane	2 12		Fair 14
	Not stated	2 Not stated	5 40+	27 None	4 None	4 25	Not stated	1 Brace	1 0		Poor 4
			Not stated	4 Not stated	5 Not stated	1 2		With support	4 0		Failure 1
								Without support	1 17		
								Unable	9 0		
								Not stated	0 2		

\* Based on operators' reports one or more years after operation.



FIG. 1-A

FIG. 1-B

Showing a typical case before and after reconstruction operation. Stability, mobility, and increase in length have been obtained.

ability, this reconstruction operation will offer stability, mobility, and an increase in the length of an already shortened extremity. (See Figures 1-A and 1-B.)

The prognosis in regard to a satisfactory end result depends especially upon the amount of previous surgery on the hip, and upon the integrity of the cartilage lining the acetabulum. It has not been felt necessary to deepen the acetabulum by a shelf or by any other operative measure, as it is normally of sufficient depth, but it may be stated at this point that the stability of the reconstructed hip joint would be greatly impaired if this operation were employed in a case presenting either acquired or congenital deformation of the acetabulum itself.

The reconstruction operation in the flexed, shortened, and adducted hips is preceded by a period of preliminary skin traction. Subcutaneous tenotomy of the contracted muscles may be desirable at this stage or at the time of open operation. The operation has previously been described in the January 1935 issue of *The Journal of Bone and Joint Surgery*.<sup>1</sup> After the operation a long plaster spica is applied with the hip in a position of full extension and from 20 to 25 degrees of abduction. This plaster spica is retained intact for two weeks, at which time the posterior portion is removed from the foot and leg, allowing active motion of the knee to be started when the patient is lying on the abdomen. Four weeks after operation, the entire plaster is removed, and the patient is fitted with a posterior molded plaster splint. He is placed on a firm mattress, and active and passive motion in the hip is begun in the overhead suspension apparatus. Care is taken at this point to keep the limb in abduction, so that a hard pillow is routinely placed between the legs to keep the

TABLE III

CLASSIFICATION OF END RESULTS IN FORTY CASES ONE OR MORE YEARS AFTER  
RECONSTRUCTION OPERATION

Classification	Criteria				
Excellent: 24 Cases (60.0 per cent.)	No pain	Stability	No support	Usual work	Flexion, more than 40 degrees
Fair: 9 Cases (22.5 per cent.)	Slight pain	Stability	No support	Usual or part work	Flexion, 20-40 degrees
Poor: 2 Cases (5.0 per cent.)	Pain	Stability	Cane or crutches	Part work	Flexion, 10-20 degrees
Failure: 5 Cases (12.5 per cent.)	Pain	Instability	Crutches	Unable to work	Good range of motion

## Analysis of Five Failures

Cases	Pain	Instability	Support	Unable to Work	Range of Motion
1	No	Yes	Crutches	Yes	90 degrees
2	Yes	No	Crutches	Yes	70 degrees
3	Yes	No	Crutches	Yes	30 degrees
4	No	No	Crutches	Yes	50 degrees
5	Yes	No	Cane	Yes	0 degrees

reconstructed hip in 10 degrees or more of abduction at all times. At the end of two or three weeks—that is, about seven weeks after operation—the patient is allowed up and, with the aid of crutches or walker, is encouraged to swing the limb in all directions and shortly thereafter to begin cautious weight-bearing. No brace or support of any kind other than crutches or walker is necessary. If the patient complains of pain or stiffness, baking and massage to the muscles about the hip and knee are advisable. Many of these patients have been immobilized in plaster for long periods before the reconstruction operation has been done and present stiffness in the knee, so that we have been routinely stretching the knee at the time of operation in order that mobilization of this joint may be hastened. The patient is encouraged to walk with one crutch or cane as soon as possible. During this postoperative period attention should be directed toward the reaction of the muscles about the reconstructed joint. Any evidence of muscle spasm of the adductors is best treated by a few days of rest in bed with or without traction to the lower extremity.

## STATISTICAL RESULTS

Tables I and II present in detail various factors that have a distinct bearing upon the results to be expected following this procedure and in

TABLE IV  
COMPLICATIONS OCCURRING IN SEVENTY RECONSTRUCTION OPERATIONS

Complication	Age (Years)	Sex	Preoperative History	Postoperative History	Operator's Reported Result
Wound Infection	56	Female	Fractured hip 1½ years before reconstruction operation (April 1935). Walked with crutches.	Few days after operation had staphylococcus infection limited to superficial tissues. At present has range of motion of 180-150 degrees. Has increase in length of 1½ inches. Good stability. Some pain in knee. Walks with cane and does usual work.	Fair
	57	Male	Fractured hip 8 months previous to reconstruction operation (March 1936). Wore brace. Presented shortening of 1½ inches.	Wound infection with persistent sinus. Stable hip. Able to climb stairs and does usual work. Motion of 180-35 degrees. Has increase in length of ½ an inch.	Fair
Contractures	18	Female	Fracture occurred 1 year previous to reconstruction operation (Sept. 1935). Had shortening of 2½ inches.	Walks without support. Does usual work. Presents slight flexion contracture. Range of motion of 160-125 degrees. Has increase in length of 2 inches. There is no pain and the hip is stable.	Fair
	51	Male	Hip nailed 13 months previous to reconstruction operation (Nov. 1935). Presented shortening of 1½ inches.	Developed abduction contracture 4 months later, and osteotomy and stretching were done. Has a stable hip with range of motion of 180-120 degrees. Has no pain and an increase in length of 1 inch.	Excellent
Psychosis	68	Male	Fracture occurred 5 years before reconstruction operation (Aug. 1933).	Fourth week after operation developed psychosis and was removed to psychopathic ward. Was able later to walk with crutches. Died a year afterward.	Poor
Dislocation or Subluxation	58	Male	Three wires inserted 2½ years before reconstruction operation (June 1937). Found the hip filled with sterile pus.	Convalescence uneventful. On weight-bearing, the hip gradually and painlessly dislocated. Had no stability and no increase in length.	Failure

	45	Female	Fractured hip 1 year previous to reconstruction operation (July 1935).	During convalescence, hip dislocated. Open reduction was done and convalescence was uneventful. Walks without support and does usual work. Good stability. Has range of motion of 180-90 degrees with an increase in length of 1 inch. Has no pain.	Excellent
	52	Female	Smith-Petersen nail inserted 10 months previous to reconstruction operation. Unable to walk.	During convalescence had subluxation of trochanter. Shelf operation was done in October 1935. Has stable hip.	Fair
	49	Female	Three years after fracture had reconstruction operation (Sept. 1937). Walked with brace and cane.	Reported immediate subluxation. Open operation with successful reduction 2 weeks later. At present walks without support. Convalescence uneventful. Has stable hip, motion of 180-30 degrees, and no pain. Does usual work.	Excellent
	56	Male	Fracture nailed 1 year previous to reconstruction operation (Feb. 1937). Walked with crutches.	Hip dislocated and open operation proved muscles not attached to new incision. Patient died 7 months later from a cerebral vascular accident. Patient had a stable hip with range of motion of 180-140 degrees. Had an increase in length of 1 inch.	Fair
Postoperative Dislocation Due to Trauma	50	Female	Fractured hip 3 months before reconstruction operation (July 1933).	Convalescence uneventful. Excellent result until 1 year after operation. Fell, dislocating hip. Operation refused.	Not stated
	64	Female	One and one-half years following fracture had reconstruction operation (Nov. 1934). Walked with braces.	Several months later, dislocation followed injury to hip. Arthrodesis done.	Not stated
Deaths	47	Female	Fracture occurred 2 years previous to reconstruction operation. Walked with crutches.	Nineteen days after operation, while in plaster, patient suddenly became cyanotic and died. No evidence of infection in wound.	



TABLE V  
SUMMARY OF DATA OBTAINED FROM QUESTIONNAIRES

Total number of reconstruction operations performed.....	121
Number of cases on which data were received.....	70
Average time reported for reconstruction operation.....	1 hour, 20 minutes
Sex incidence:	
Males.....	16
Females.....	54
Age distribution:	
Under 40 years.....	6
40 to 50 years.....	8
50 to 60 years.....	31
60 to 70 years.....	19
Over 70 years.....	6

End Results One or More Years after Reconstruction Operation

Type of Case	No. of Cases	Excellent (Per Cent.)	Fair (Per Cent.)	Poor (Per Cent.)	Failure (Per Cent.)
No previous surgery.....	41	60.97	26.85	9.75	2.43
Previous surgery.....	13	15.38	61.54	15.38	7.70
Preoperative evidence of arthritis.....	10	30.0	40.0	30.0	0.00
No preoperative evidence of arthritis.....	38	50.0	36.84	10.52	2.64
Complete absorption of neck.....	37	59.5	27.0	10.8	2.7
Incomplete absorption of neck.....	15	20.0	73.4	6.6	0.00

general prove that those cases not complicated by arthritis or previous operation give the most satisfactory functional results. Of the cases with no previous surgery, 60 per cent. could be classified as excellent as against 15 per cent. of the cases in which previous surgery had been done on the reconstructed hip. In the cases with preoperative evidence of arthritis, 30 per cent. could be classified as excellent, while in those without arthritis 50 per cent. were excellent. If the neck had been completely absorbed, the result was a much better hip and could be classified as excellent in 59 per cent. of the cases and fair in 27 per cent. However, in the cases in which the neck had been incompletely absorbed and the remaining portion was removed at operation, the results were classed as excellent in 20 per cent. and fair in 73 per cent.

Forty fully completed questionnaires were returned (Table III), and, instead of using the individual operator's opinion regarding the result, as has been done in Table V, the author has analyzed these cases on the following basis: In patients with no pain in the reconstructed hip, stability, ability to walk without support and to return to their usual work, and a range of flexion of more than 40 degrees from the fully

extended position, the results were classed as excellent. There were twenty-four patients (60.0 per cent.) in this group. In the nine patients (22.5 per cent.) presenting slightly less than this ideal, the results were classed as fair. In two cases (5.0 per cent.) the results were poor, and five cases (12.5 per cent.) were regarded as failures. In all of these cases classed as failures, the patients had a good range of motion and only one had an unstable hip, but they had persistent pain, were unable to do usual or partial work, and walked with the aid of crutches. Based, therefore, on these arbitrary criteria we find that of this series of forty cases in thirty-three (82.5 per cent.) the results were classed as satisfactory and in seven (17.5 per cent.) as unsatisfactory.

The complications in the main have to do with the subluxation or dislocation following the reconstruction operation (Table IV). This complication may be dependent upon several factors, and, in at least two of the cases, it occurred because proper support was not given during the convalescent stage. Undoubtedly these hips should be kept in slight abduction after removal of the plaster and at the time active and passive movement is instituted. A simple expedient of placing a pillow between the legs has been routinely used and will keep the affected limb from swinging over into adduction during this stage. Reoperation in one case disclosed the fact that the abductor muscles had become loosened from their new insertions. In every case in which a reoperation was permitted, the surgeon reported a stable hip and a fair or excellent result. It is felt, therefore, that, if care is directed toward keeping the limb in some abduction during the first few weeks of activity, subluxation or dislocation in great part will be avoided. As a further means of assuring stability in these reconstructed hips it is advisable to delay compensating for the shortening by any shoe elevation for at least one year after the operation. This keeps the limb in slight abduction for a long period during weight-bearing and is an added factor toward assuring stability.

#### SUMMARY

1. This type of reconstruction operation has proved suitable for those cases of old ununited fracture of the neck of the femur which present complete absorption of the neck and necrosis of the head.

2. The results are better in cases without preoperative evidence of arthritis about the joint and without previous hip-joint surgery (Table V).

NOTE: These questionnaire data on the treatment of seventy cases of old ununited fracture of the neck of the femur are gratefully acknowledged. The material has been collected and reviewed through the cooperation of the following orthopaedic surgeons: R. E. Burns, W. C. Campbell, William B. Carrell, Ralph K. Ghormley, P. M. Girard, Halford Hallock, M. S. Henderson, H. E. Hipps, Samuel Kleinberg, Arthur Krida, I. William Nachlas, Peter Rizzo, Percy W. Roberts, A. D. Smith, J. S. Speed, Arthur Steindler, Richmond Stephens, George Van Gorder, Lewis C. Wagner, Armitage Whitman, and Philip D. Wilson.

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# ARTHRODESIS FOR UNUNITED FRACTURE OF THE NECK OF THE FEMUR \*

BY A. BRUCE GILL, M.D., PHILADELPHIA, PENNSYLVANIA

Arthrodesis of the hip should be considered as one of the possible methods of dealing with a particular case of non-union of the neck of the femur. The surgeon should be thoroughly familiar with all the operative procedures that have been found useful in this condition and should be able to weigh the advantages and the disadvantages of each method and to select that one which will give to his patient the best chance for a satisfactory functional result.

Freedom from pain and restoration of bodily function are the essential criteria by which all end results must be estimated. Satisfactory function means stability of the extremity in standing and in walking. It does not necessarily include mobility of the hip. Some individuals may need motion in the hips to follow their occupations, but many with stiff hips are able to do everything they desire except to lace the shoes.

No surgeon, however optimistic, makes claim to curing all ununited fractures of the hip by any method which is designed to obtain union, or by any method of reconstruction of the hip, or by osteotomy of the femur. Any of these operations may fail to relieve pain and to restore function. Nor will it do to assure the patient that if the contemplated operation is not successful other operations may be tried. If the patient is no longer young, his remaining years are all too few to be consumed by unsuccessful operations. Continued pain and inactivity are too threatening to life itself. The surgeon must select at the time of operation that procedure which will afford the optimal expectation of cure. It is not sufficient to know that 75 per cent. of the patients are cured by a certain operation. We must determine in advance whether our particular patient will be among the remaining 25 per cent. We should know the causes of our failures and should be able to recognize in advance the conditions in any patient which must almost inevitably lead to such failures.

This is a very heavy responsibility that is placed upon the surgeon. It demands a knowledge and a surgical judgment that probably none of us possess completely,—a knowledge of all the mechanical and physiological factors involved in fracture of the hip, such as lines of force and strain, the conditions of regenerative and degenerative changes in bones and joints both generally and in any particular patient, and the causes and the sources of pain.

## INDICATIONS FOR ARTHRODESIS OF THE HIP

It may be appreciated from the preceding paragraphs that the indications for arthrodesis are inseparably bound with the indications and the contra-indications of all other procedures.

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 19, 1939.



FIG 1

K. S. Intra-articular and extra-articular fusion eight years after operation.

If one accepts the dictum, which the author believes to be true, that a hip fused in the proper position affords the patient a painless and useful extremity, then it naturally follows that arthrodesis of the hip is indicated after other operations have failed. The author's first arthrodesis for non-union was done in 1928 for this very reason. The patient was sixty-five years of age and, because of a heart lesion, he was a very bad surgical risk. A reconstruction operation performed two years before had left him with so painful a hip that he preferred death to living longer in pain. The result of the arthrodesis was restoration to a happy and useful life.

However, if arthrodesis is useful as a last resort, should it not also be the primary operation of choice for certain patients who will fail to be cured by any other method of operation? This brings up one of the most important questions in regard to treatment of ununited fractures of the neck of the femur: In what cases is it hopeless to attempt to secure union of the fragments or to effect a painless and stable hip by reconstruction or osteotomy? Each surgeon will answer this question in the light of his own knowledge and experience. The author can but mention here the conditions which cause him to decide upon primary arthrodesis. This final decision is not reached until the hip joint has been opened and thoroughly inspected at the time of operation.

*Attempt to secure union of the fragments* is not undertaken when:

1. There has been rapid absorption of the neck after the original fracture. This indicates severe injury to the blood supply of the neck and militates against bone regeneration.

2. There is gross necrosis of the head. It has no blood supply, as is evident on digging up the fractured surface with a gouge. It is dry and pithy, or it is so soft that it can be scooped out almost with the fingers. The cartilage is yellow, eroded, and partially absorbed.

3. The neck has been completely absorbed. The fractured surfaces of both the head and the femur at the base of the neck are concave and cannot be approximated.

4. Chronic arthritis is evident. The synovial membrane is thickened and discolored. Villous formations may be present, with loose bodies within the joint and with an excessive amount of thick glairy fluid. The acetabular cartilage may give evidence of degenerative changes. There may be growths around the acetabular rim.

*A reconstruction operation* is not indicated when:

1. There is the evidence of chronic synovitis and arthritis already enumerated.

2. There is complete or almost complete absorption of the neck. The absence of the neck renders it very difficult for mechanical reasons to maintain the end of the femur in the acetabulum. The mechanical



FIG. 2

C. W. Nine years after operation. Failure of arthrodesis. Perfect functional result. Patient is a mail carrier.

law of the resolution of forces which strike against an oblique surface whereby they are divided into two components—of which one is perpendicular to the plane and one is parallel to it—explains why the femur cannot remain within the socket unless it is kept in abduction on weight-bearing.

3. Theoretically, if a successful reconstruction of the hip is dependent on abduction of the femur, the pelvis is necessarily tilted downward on the affected side and upward on the opposite side. Curvature of the spine must be present on weight-bearing. In the aged, this may produce a chronic backache.

*Osteotomies of the femur* also are effective chiefly because the abduction of the lower fragment produces a tilting of the pelvis, and these operations are open to the same theoretical objections. Therefore, an arthritic or rigid spine is a contra-indication to both a reconstruction operation and an osteotomy.

Arthrodesis of the hip is done primarily, therefore, when these contra-indications to other operations are present.

#### TECHNIQUE OF OPERATION

The author uses the Ollier incision, which starts at the anterior superior spine of the ilium and is curved downward and backward about three inches below the top of the greater trochanter. The joint is opened by incising the capsule longitudinally along the anterior superior portion of the neck. The structures of the hip joint, bones, cartilage, and synovial membrane are carefully inspected, and the final conclusion as to the type of operation to be performed is then reached.

If one proceeds with an arthrodesis, he first strips off the attachment of the capsule to the femur and strips subperiosteally the muscles attached to the greater trochanter and to the upper portion of the shaft for an inch below the greater trochanter. The femur is thus mobilized, and its upper extremity is denuded of periosteum.

The head of the femur is removed from the acetabulum and the latter is denuded of its articular cartilage and is enlarged upward like a dome. The end of the femur is then placed securely within the dome-shaped acetabulum from which it cannot become displaced.

In some cases the outer portion of the greater trochanter and the upper part of the shaft are split off, turned around, and driven into a cleft made in the ilium just above the acetabular rim. The other end of this graft then falls in contact with the femur. This is done to produce an extra-articular fusion in conjunction with the intra-articular arthrodesis.

The wound is then closed in the usual manner. Fixation in a plaster cast for twelve weeks is routinely carried out.

#### END RESULTS

Complete bony fusion occurred in six out of ten cases. These patients all resumed their normal mode of living.

In the four cases in which fusion did not take place, all of the patients were free from pain and were able to do their usual work. One man, who was operated upon in 1929, has, ever since his recovery from the operation, followed his occupation as a mail carrier and walks daily a distance of from twelve to fifteen miles while carrying his heavy mail bags. In none of these cases did the femur become displaced from the domed acetabulum.

In cases where considerable new bone was laid down about the margin of the joint there was still no pain on function. Possibly this indicates that osteophytes or exostoses about joints are not sensitive, and that the pain which occurs in hypertrophic joints is due to traumatism and inflammation of the synovial membrane.

#### CONCLUSIONS

In conclusion, it may be stated that arthrodesis is indicated when other operations have failed, and that it should be employed primarily when there are definite contra-indications to other operations. One may expect the functional result to be satisfactory.

## A TWO-STAGE OSTEOTOMY

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The purpose of this article is to describe a type of osteotomy for use in certain areas of the skeleton where a one-stage osteotomy formerly has been associated with the danger of either non-union or slipping. It was devised to be used specifically in cases of congenital bowing of the lower end of the tibia, cases in which the usual type of osteotomy has so often led to non-union. It is felt that it is applicable to other locations in the body.

The chief directions for carrying out the procedure are: (1) operate on but half of the bone at the first stage; (2) remove a segment of the shaft, amounting to half the diameter of the bone; (3) cut up this piece of bone into small chips; (4) replace the chips into the gap caused by their removal; (5) wait until adequate bone repair and callus formation have occurred to offer stability with adequate blood supply; and then (6) osteotomize the remaining half of the shaft to correct the deformity.

In the following case this procedure was employed twice at that danger area of the tibia, the junction of the lower and middle thirds.

### CASE REPORT

A. R. (No. 152121), a six-year-old girl, had been observed in the Clinic since the age of one year for an unusual form of severe bowing of the femora and tibiae and for coxa vara. Evidence of rickets was present. Tibial osteotomies for torsion had been done elsewhere, and femoral osteotomies for severe varus had been done at this Hospital. In spite of what was considered an adequate vitamin diet, the deformities had recurred and progressed.

Since most of the varus present in the tibiae was at the junction of the lower and middle thirds, it was decided to operate at this site and to attempt the two-stage procedure.

#### *Left Tibia*

On October 27, 1937, the first stage of this operation was performed on the left tibia. A curved incision was made over the lower aspect of the tibia with the convexity facing laterally. Two and one-half inches of the periosteum from the medial half of the tibia only was elevated. Half the diameter of the shaft of the tibia was removed throughout the area of elevated periosteum. The removed bone was cut up into small bone chips and then replaced in the defect caused by its removal. The periosteum was closed tightly over the chips, and a long leg cast was applied.

Nineteen days later, on November 15, 1937, the second stage of the operation was performed. The previous incision was entered and a part of the former operative area was exposed. The chips were found to have a plastic consistency. They were partially discrete and were all firmly bound together by abundant callus. The



lateral half of the tibia was then osteotomized, and a wedge was removed laterally, at about the level of the middle of the former operative site. The fibula was osteotomized obliquely at a level one inch higher than the tibial osteotomy. The leg was swung into valgus, and the varus deformity was corrected. The area of chips and callus bent easily, but did not break, due to its plastic consistency.



FIG. 1

Left tibia, January 16, 1937, before operation.

#### *Right Tibia*

The first-stage operation was performed on the right tibia on March 2, 1938. Nineteen days later, the second stage was done. A new incision was made between the tibia and the fibula to give exposure to the two bones. Only the lateral half of the tibial periosteum was exposed, so that the area of chips was not visualized. This precaution was taken to prevent the tearing of new blood vessels in the area of repair. It was noticed that the periosteum covering the lateral half of the tibia was very oedematous, and that the oedema ceased



FIG. 2

Left tibia, November 10, 1937, two weeks after first stage of osteotomy. Half of the diameter of the bone remains intact. The bone chips are becoming confluent.

proximally and distally five-tenths of a centimeter beyond the level of the chips. A wedge of bone was taken from the lateral half of the tibia to correct the varus. The fibula was osteotomized by an oblique chisel cut, running from above, downward, and



FIG. 3

Left tibia, November 17, 1937, two days after completion of osteotomy (second stage). Note bending of callus mass containing the bone chips.

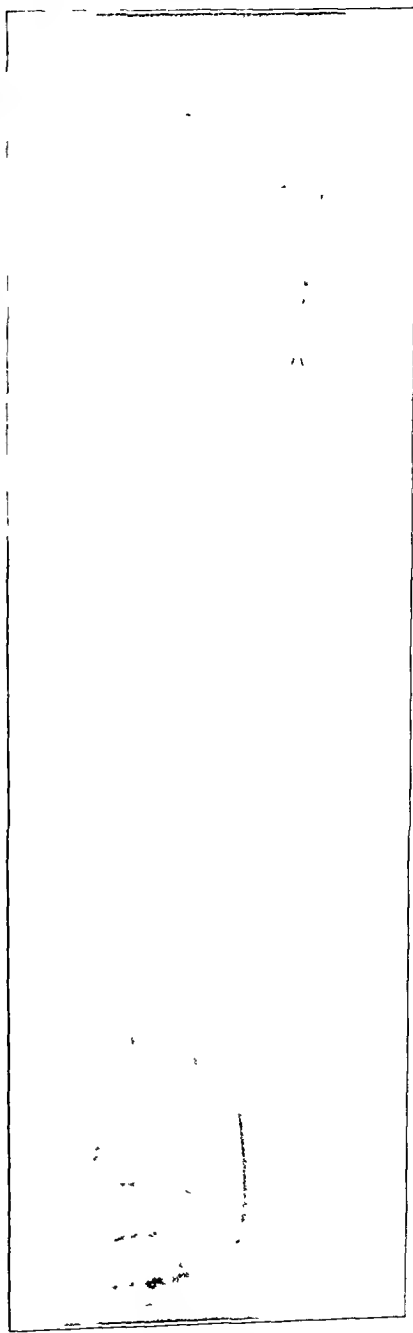


FIG. 4

Left tibia, December 23, 1938, thirteen months after completion of osteotomy.

medially. The leg showed considerable laxity, and the callus and chips did not offer much support. Torsion could have been corrected easily, if desired, without too much tightening of the tissues or danger of embarrassing the blood to the callus. It was felt that nineteen days in this case was perhaps a little too early for the second operation. The firmness of the callus would have been increased by a longer wait, and the stability offered would have been greater.

Both tibiae, after their two-stage operations, healed solidly with no complications.

#### DISCUSSION

It is felt that, for the first operation to correct varus, it is better to choose the medial half of the tibia than the lateral half, because, when the wedge osteotomy is done later, the cut tibial surfaces will be brought into contact as the leg is swung into valgus. If the lateral half is chosen first, the cut tibial surfaces will be separated as the leg is swung into valgus.

When only half of the tibial shaft is removed at the first operation, the blood supply of the remaining half is not interrupted severely enough to cause absorption of the bone. This remainder of the bone renders adequate support to the tibia until the callus has become of sufficient firmness.

If callus does not form about the chips, the second stage of the procedure should not be done until additional chips have been added to the operative area and callus has been formed.

# SUPRACONDYLAR FRACTURE OF THE FEMUR WITH ANTERIOR POSITION OF THE LOWER FRAGMENT

BY DRURY HINTON, M.D., DREXEL HILL, PENNSYLVANIA

In reviewing the literature of supracondylar fractures of the femur, one is struck by the paucity of reference to the possibility of the anterior position of the lower fragment. This is understandable in the case of textbooks for student teaching, but the omission of this condition in standard works on fractures is surely indicative of the rarity of its occurrence. Reference to the anterior position of the lower fragment—the usual deformity—in epiphyseal separation of the lower end of the femur is, of course, common; and it is noted in connection therewith that a number of writers (Russell, Bellin) stress the fact that it has been mistaken for a dislocation of the knee joint.

In only one of nine standard works on fractures (Speed) has the author found any reference to this type of deformity. In this book there is an illustration of the deformity, but no discussion accompanies it. The only other reference found was in an article by Lee and Veal, in which Figures 1-W and 1-X showed a supracondylar fracture with anterior position of the lower fragment. This fracture was treated by Russell traction, and on discharge the fragments showed alignment of 50 per cent., overlapping of 25 per cent., and end-to-end apposition of 22 per cent.

The author is well aware that anterior position may occur secondary to an unsuccessful attempt at reduction, and such cases were discounted in this article. Among his surgical confreres he could find but one case similar to the other one reported here, and he is indebted to Dr. Bruce Fleming for permission to use this case.

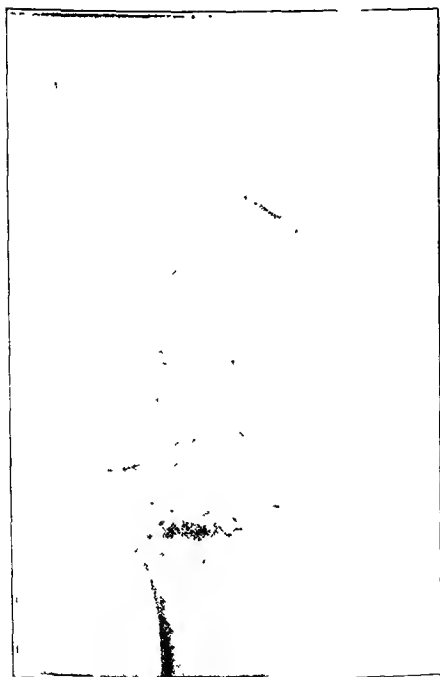


FIG. 1

Case 1. Lateral view on admission.

CASE 1. P. H., white, male, aged nine, was struck by an automobile, and sustained a transverse supracondylar fracture without lateral displacement (Fig. 1). Russell traction aggravated the deformity, which fact was readily appreciated the following day when it was found under the fluoroscope that flexion of the knee tilted the fragments, whereas extension brought them end to end. Traction produced slipping, so that the ultimate dressing was with the leg lying in a Thomas leg splint with Pearson's attachment for future mobilization (Figs. 2-A and 2-B). The splint was suspended with the knee extended and without traction. A roentgenogram was taken every week. The boy was

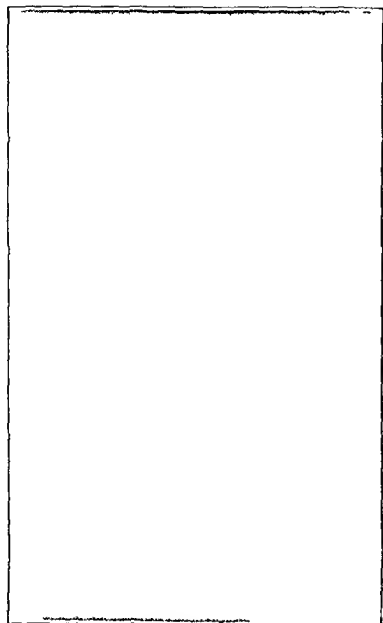


FIG 2-A



FIG 2-B

Case 1. Anteroposterior and lateral views one week after reduction

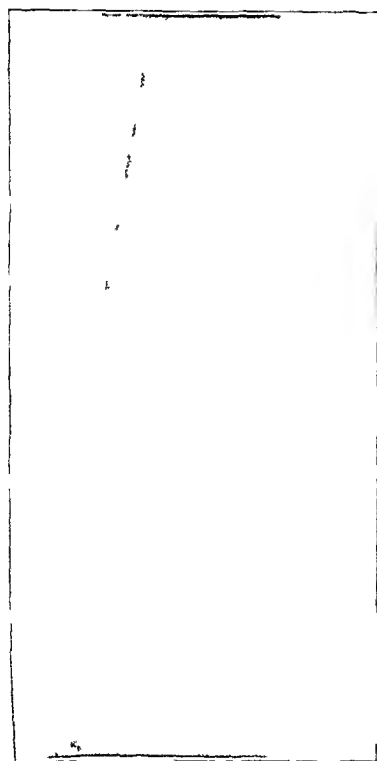


FIG 3-A

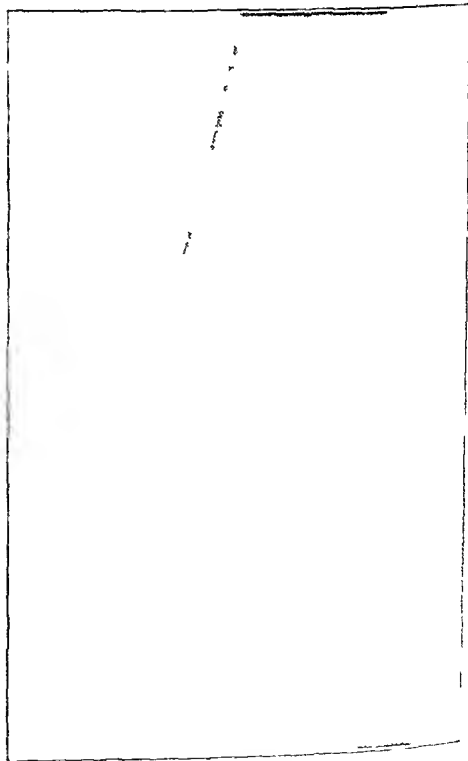


FIG. 3-B

Case 1. Anteroposterior and lateral views two years and ten months after reduction.

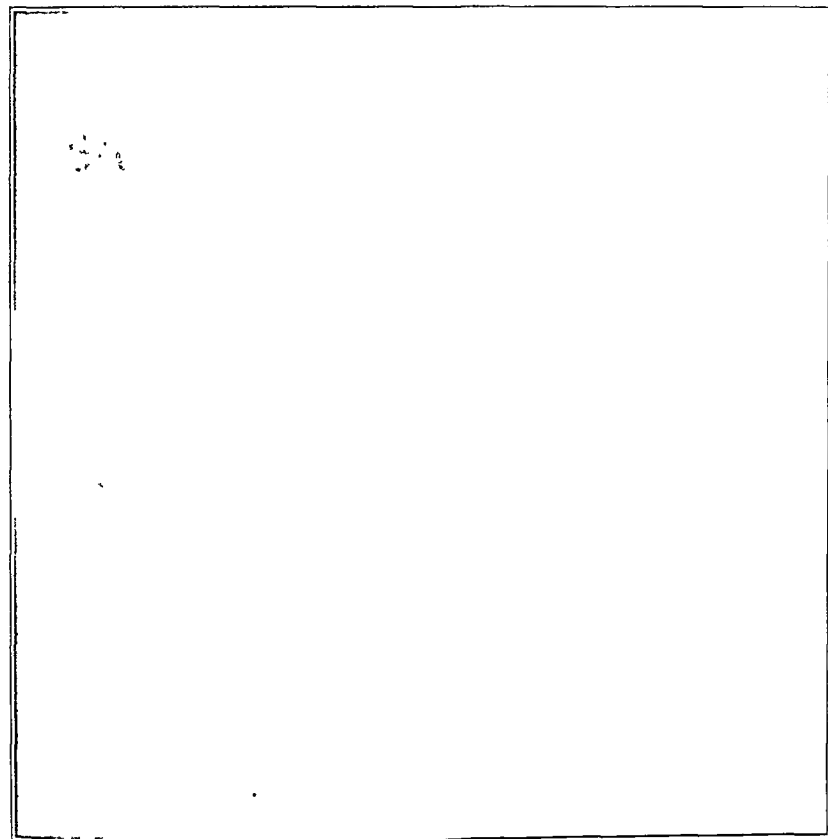


FIG. 5

Case 2. Lateral view on the following day, showing perfect reduction.

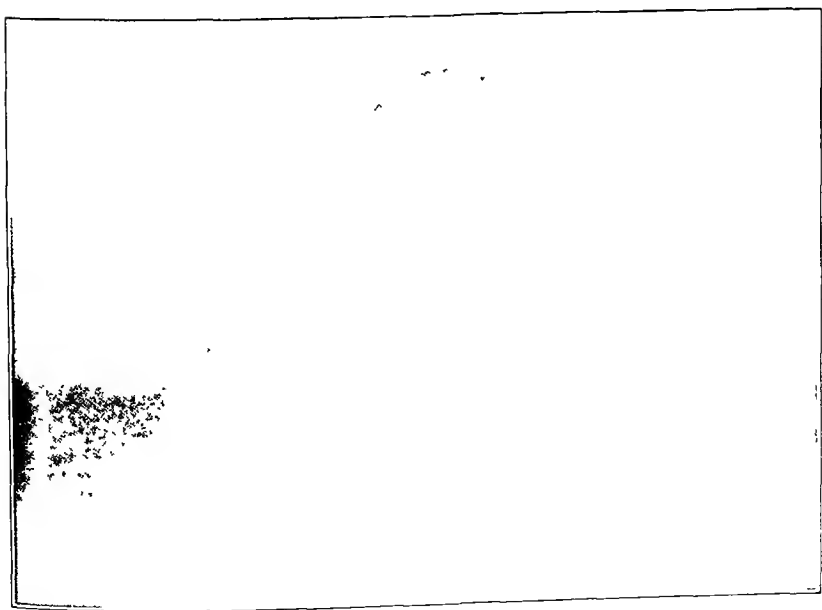


FIG. 4

Case 2. Lateral view showing anterior position of the lower end of the femur.

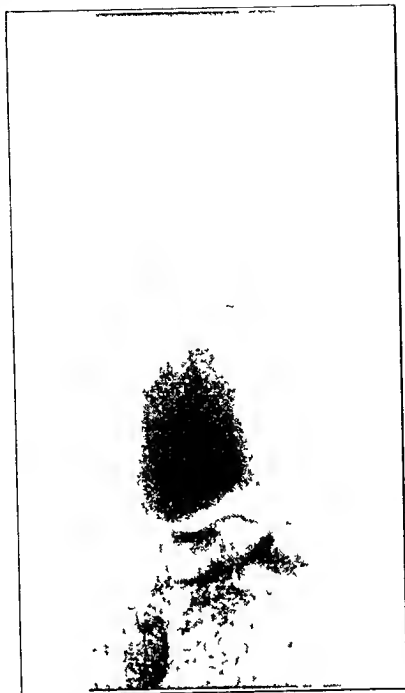


FIG. 6-A

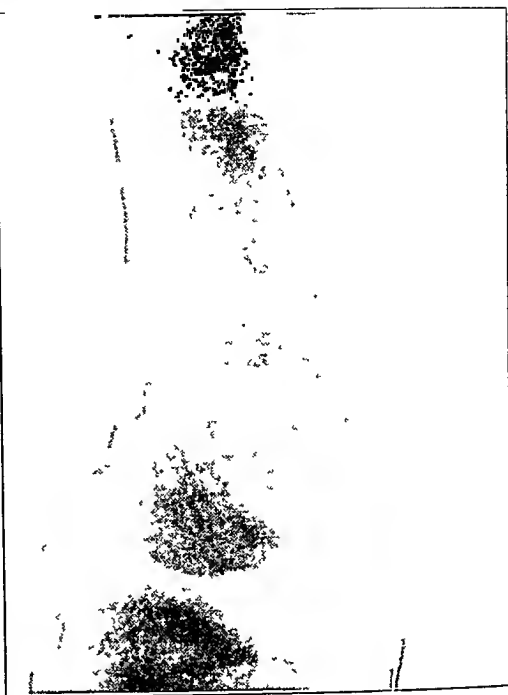


FIG. 6-B

Case 2. Anteroposterior and lateral views seven years later.

discharged on the fortieth day, with complete flexion and extension at the knee joint. There was, however, one-fourth of an inch of shortening. It is of interest to note that on the twenty-fifth day acute appendicitis developed and an operation was performed through a gridiron incision with the splint removed and the leg held by sandbags. Follow-up roentgenograms (Figs. 3-A and 3-B) were taken two years and ten months after injury. At that time both legs were of the same length, and there was no disability.

CASE 2.\* H. R., male, white, aged fifteen, injured his left knee while playing football. He was carrying the ball and was hit from the left side, the left leg being straight and the right one off the ground. On admission, the knee was slightly flexed, and the interne thought that the injury was a dislocated knee. The lower fragment was displaced anteriorly and overlapped (Fig. 4). Reduction was easy, and the position was verified through the fluoroscope (Fig. 5). The knee was held in flexion by an adhesive strap, which was removed on the eighteenth day. On the thirty-sixth day, union was excellent; flexion and extension were complete. Follow-up roentgenograms (Figs. 6-A and 6-B) were taken seven years later, at which time it was found that both legs were of the same length. The affected knee could be somewhat hyperextended as compared to the other one; otherwise there was no difference between them. There was no disability.

\* Courtesy of Dr. Bruce Fleming.

It is to be noted that Case 2 responded to the method used in reduction and retention of epiphyseal separation, while Case 1 had to be treated otherwise. This illustrates very well the value of the fluoroscope in helping one individualize the treatment of the unusual case.

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## GOLD THERAPY IN RHEUMATOID ARTHRITIS

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The treatment of the rheumatoid (atrophic or infectious) type of arthritis by gold salts has gained prominence in the last years in Europe and the British Empire. In the United States this therapy has not won, as yet, wide recognition. Two of the authors (Sashin and Spanbock), in 1937, reported satisfactory results from this method in twenty-two cases of rheumatoid arthritis. Because of the frequency and the serious nature of rheumatoid arthritis, and the efficiency as well as the dangers of gold therapy, the authors now present the results of their study of a larger number of cases.

A review of the older literature was presented in the first report. In this paper some of the significant contributions of the last few years will be considered. Perles, in a paper on the indications and contra-indications of gold therapy, stressed the importance of making a careful diagnosis and of giving gold only in rheumatoid arthritis. He warned against the indiscriminate use of gold. Baker also stressed the fact that gold therapy should be used only in rheumatoid arthritis. Phillips, in a paper on the treatment of arthritis with gold salts, used myocrisine in cases of rheumatoid arthritis. Only two patients improved. However, his material is too small to be conclusive. The most extensive study on gold therapy in rheumatoid arthritis was made by Hartfall, Garland, and Goldie. In their latest paper they analyzed the results of 900 cases, of which 750 belonged to the rheumatoid type. In 690 of these, one full course of gold treatment had been completed, with the following results: 9.9 per cent. were apparently cured and 56.8 per cent. were markedly improved,—a total of 66.7 per cent. who were very much improved. Nineteen and two-tenths per cent. were moderately or only slightly improved; 14.1 per cent. remained unimproved. Seven deaths (0.78 per cent.) occurred, which were regarded as being principally due to the toxic effect of gold. Three patients had purpura haemorrhagica; two patients had subacute liver necrosis; one patient had granulocytosis; and another had exfoliative dermatitis. The preparations used by the authors were crisalbine (sodium gold thiosulphate), lopion (sodium gold allyl-thio-urea-benzoate), myocrisine (sodium gold thiomalate), and solganal B (gold thioglucose).

From this review, the value of gold therapy is evident. On the other hand, there is a serious element of danger on account of a high percentage of toxic reactions with even fatal results in some cases. The

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TABLE I  
AGE DISTRIBUTION IN EIGHTY CASES \*

Age (Years)	No. of Cases	Per Cent.
18-20.....	2	2.50
21-30.....	15	18.75
31-40.....	24	30.00
41-50.....	29	36.25
51-60.....	9	11.25
61-65.....	1	1.25
Total.....	80	100.00

\* Average age: 39.7 years.

selection of cases for gold therapy is, therefore, limited to those in which the disease is active and advanced, and in which other treatment has previously failed. We must consider contra-indications and guard against complications before and during the course of treatment. For this study we have selected eighty cases of active, progressive, and advanced rheumatoid arthritis, which were refractory to other therapeutic measures.

#### MATERIAL

The eighty cases presented the clinical and laboratory findings of the rheumatoid types of arthritis of unknown etiology. In sixty-four cases (80 per cent.) numerous joints were involved. In five (6.3 per cent.) the knee joints were chiefly affected. Eleven patients (13.7 per cent.) suffered from an ankylosing spondylitis. Fifty-two patients (65 per cent.) were females; twenty-eight patients (35 per cent.) were males. The ages ranged from eighteen to sixty-five years, the average age being thirty-nine and seven-tenths years (Table I). The duration of the disease was from one to twenty-five years, the average duration being five and four-tenths years (Table II). Follow-up examinations after the treatment varied from six months to five years.

#### PREPARATIONS AND DOSAGE

At first, organic and colloidal gold solutions were given by mouth. Collodaurum (Kahlenberg) by mouth did not prove efficient. Solganal pills were discontinued because of severe reactions, especially skin eruptions and gastro-intestinal disturbances, which appeared before improvement of the joint conditions. In this series, sixty-three patients received intravenous or intramuscular injections of gold thiosulphate solutions. Seventeen patients were given intramuscular injections of a colloidal gold solution (auroccin). Our standard course of sodium gold thiosulphate was from twenty-five to fifty milligrams once or twice weekly, according to the reaction, until one gram of gold thiosulphate had been administered. In case of toxic reactions, injections were suspended until

TABLE II  
DURATION OF DISEASE IN EIGHTY CASES \*

Years	No. of Cases	Per Cent.
1 .....	13	16.25
2-5 .....	40	50.00
6-10.....	17	21.25
11-15.....	6	7.50
16-20.....	3	3.75
25 .....	1	1.25
Total.....	80	100.00

\* Average: 5.4 years.

the symptoms subsided. Treatment was then resumed, starting with ten milligrams.

Reliable preparations of various quantities of gold thiosulphate in crystals are on the market. We use one distributed as a stable sterile solution of 37 per cent. gold salt in five-cubic-centimeter rubber-capped vials. This obviates the necessity of preparing fresh solutions and affords greater economy, because any amount can be withdrawn without contaminating the rest. Aurocein, according to the manufacturer, is a sterile 5-per-cent. solution of a sulphydryl-gold-naphthyl-trisulpho-carbonium derivative. It is supplied in two-cubic-centimeter ampoules. A brief report of its action was published by Oren. The course of treatment which we have given consists of one ampoule twice a week until a total of twenty-five ampoules have been given. In case of reaction, the dose is reduced to one-half an ampoule.

The full course was given to all except four patients. In three of these cases, the treatment was discontinued on account of severe reactions. One patient was free from symptoms after 500 milligrams of gold thiosulphate. The gold course was repeated after three months in about 16 per cent. of Kling's series. We have now adopted the recommendation of Forestier and of Hartfall, Garland, and Goldie to repeat the course of treatment at least once, even in the absence of clinical symptoms.

#### THERAPEUTIC RESULTS

The basis for the classification of the therapeutic results was the effect on the local and general clinical symptoms and on the sedimentation rate of the erythrocytes. We considered as failures the cases of improvement in only the subjective symptoms—such as pain, stiffness, general well-being—without accompanying improvement in the objective findings—such as tenderness, swelling, restriction of motion, and effusion. We have regarded as markedly improved only the cases which show a drop in the blood sedimentation rate, approaching the normal range, in addition to the amelioration of the subjective and objective symptoms. We have not listed cures as yet, because we feel

that the observation period must extend for a number of years before such a chronic disease can be described as definitely eradicated.

Table III summarizes the results. Of the eighty patients, thirty-five (43.75 per cent.) were very markedly improved, and thirty-one (38.75 per cent.) were moderately or slightly improved. A total of 82.5 per cent. have benefited to some extent. Fourteen patients (17.5 per cent.) experienced no improvement under the treatment. This includes three cases in which treatment was discontinued on account of severe reactions. Of the eleven patients with ankylosing spondylitis, six (54.55 per cent.) were improved and five (45.45 per cent.) were not improved (Table IV). The results are inferior to those obtained in cases of rheumatoid arthritis with involvement of the peripheral joints. This is in agreement with the observations of English authors, while Forestier claimed equally good

TABLE III  
THERAPEUTIC RESULTS

Results	No. of Cases	Per Cent.
Very marked improvement.....	35	43.75
Moderate and slight improvement.....	31	38.75
No improvement, or worse.....	14	17.50
Total.....	80	100.00

results in ankylosing spondylitis as in rheumatoid arthritis of the peripheral joints. Of thirteen cases in which the duration of the disease was not longer than one year, there was marked improvement in seven (53.85 per cent.) and moderate or slight improvement in five (38.46 per cent.), making a total of 92.31 per cent. in which there was improvement. In only one case (7.69 per cent.) was there no improvement. Forestier had 50 per cent. apparent cures in cases of less than two years' duration and only about 25 per cent. apparent cures in cases of more than two years' duration. Hartfall, Garland, and Goldie have expressed the hope that gold therapy given early enough will prevent the progress of rheumatoid arthritis. Our results approximate but are not as good as those of Hartfall and his co-authors, who reported improvement in 85.9 per cent. and no improvement in 14.1 per cent. This may be due to the inclusion in their series of a greater percentage of early cases. The therapeutic effects and the toxic reactions were approximately the same with both preparations used. The percentage of very marked improvement was higher with sodium gold thiosulphate (50 per cent.) than with aurocein (29.4 per cent.) in a series of thirty-five cases. On the other hand, no improvement was present in 16 per cent. of the cases in which sodium gold thiosulphate was given and in 11.6 per cent. in which aurocein was administered. Improvement in most cases appeared after half of the course, but amelioration may set in early or after completion of the course.

TABLE IV  
RESULTS IN ANKYLOSING SPONDYLITIS

Results	No. of Cases	Per Cent.
Marked improvement.....	5	45.45
Moderate improvement.....	1	9.10
Unimproved.....	5	45.45
Total.....	11	100.00

## EFFECTS ON SEDIMENTATION RATE

The original and a modified Westergren method of estimation of the blood sedimentation rate were used. Table V summarizes the results before and after treatment. Before treatment only one patient showed a normal sedimentation rate of seven millimeters in an hour (maximum normal value, about ten millimeters); this patient did not respond well and the treatment was discontinued after only seven injections. We felt justified in counting this among the failures. Fifty-one per cent. of the cases showed a moderate increase up to forty millimeters; 49 per cent. showed elevations exceeding forty millimeters. After treatment, the sedimentation rate was normal (ten millimeters) in 33 per cent.; under twenty millimeters in 61 per cent.; and under forty millimeters in 86 per cent. In only 14 per cent. did the sedimentation reaction remain elevated over forty millimeters in one hour. These patients and some with moderate increases in the sedimentation reaction remained unimproved. The average sedimentation rate before treatment was forty-one and seven-tenths millimeters, and after treatment twenty-four and two-tenths millimeters. Dawson and his associates rightly emphasized the importance of the sedimentation rate for differential diagnosis of the

TABLE V  
SEDIMENTATION OF ERYTHROCYTES

Before Treatment *			After Treatment †		
Millimeters	No. of Cases	Per Cent.	Millimeters	No. of Cases	Per Cent.
7-10.....	1	1.28	3-10.....	17	33.33
11-20.....	11	14.10	11-20.....	14	27.45
21-30.....	10	12.82	21-30.....	6	11.77
31-40.....	18	23.08	31-40.....	7	13.73
41-50.....	13	16.67	51-60.....	2	3.92
51-60.....	12	15.38	61-70.....	2	3.92
61-70.....	8	10.26	71-80.....	2	3.92
71-81.....	5	6.41	96.....	1	1.96
Total....	78 ‡	100.00	Total....	51 ‡	100.00

\* Average: 41.7 millimeters

† Average: 24.2 millimeters.

‡ The other cases were checked by the Linzenmeier method, which determines the time required for the sinking of the red blood cells a distance of eighteen millimeters.

chronic arthritides. It is a highly sensitive indicator of activity, because it remains elevated after marked clinical improvement, and a renewed increase is often present long before other symptoms of recurrence have developed. It is, therefore, very useful as a check on the results of the therapy, and acts as a brake against overenthusiasm. We must, however, remember that the blood sedimentation rate is not a specific test for rheumatic disorders, and other inflammatory conditions of the patient not related to the arthritis may influence the sedimentation rate as well. This explains occasional discrepancies between the sedimentation rate and the clinical symptoms after gold therapy.

#### TOXIC REACTIONS

Local reactions, consisting of increased pain in the joints, occurred in about 25 per cent. of the cases, mostly during the first half of the course of treatment. They were transient and not severe. Hartfall, Garland, and Goldie, and Copeman and Tegner regard them as a good prognostic

TABLE VI  
SYSTEMIC AND REMOTE REACTIONS

Reactions	No. of Cases	Percentage of Reactions	Percentage of Total Cases
Fever.....	1	5.26	1.25
Dizziness.....	1	5.26	1.25
Pruritis and urticaria.....	13	68.43	16.25
Erythema.....	1	5.26	1.25
Stomatitis.....	2	10.53	2.50
Diarrhoea.....	1	5.26	1.25
Total.....	19	100.00	23.75

sign. General and remote reactions occurred in nineteen cases (23.75 per cent.), and are enumerated in Table VI. In only three cases (3.75 per cent.) were the reactions of a more severe nature, so that treatment was discontinued as a measure of precaution. In all other cases the reactions were mild, and did not interfere with the continuation of ambulatory treatment. Generalized reactions with a rise in temperature for two days, not exceeding 101.4 Fahrenheit, with malaise and gastrointestinal distress occurred in one case. Such cases are described by the French authors as "*grippe aurique*". In other cases a transitory dizziness occurred during the course of treatment. The skin was involved fourteen times (17.5 per cent.). In one case there was present a more generalized erythema. Thirteen patients suffered from localized pruritis and urticaria. The prevalence of toxic reactions of the skin is stressed by most authors. The occurrence of exfoliative dermatitis, the most dangerous form, fluctuates very highly. Each of the following authors

quotes two cases: Copeman and Tegner among fifty-one; Crosby among twenty-seven; and Forestier among 550. Hartfall, Garland, and Goldie did not see more than five cases out of 900. One factor in this high incidence is the administration of too high a dosage. It appears also that allochrysin is perhaps more apt to give severe skin reactions. Stomatitis, with sore tongue and metallic taste, was complained of in two of our cases. As far as gastro-intestinal reactions are concerned, only one case of diarrhoea occurred. A transient kidney irritation, consisting of a trace of albumin and a few erythrocytes in the urine, was encountered only once. The blood system was only slightly affected in our cases. The repeated blood counts did not show appreciable changes in the red and white counts. While reactions of the blood system are comparatively rare, they are important because of their dangerous character. Cases of severe and sometimes fatal agranulocytosis were reported by Crosby (one case), Forestier (two cases), and Hartfall, Garland, and Goldie (one case). One case of sudden hypochromic anaemia (hemoglobin, 64 per cent.) and two of macrocytic anaemia occurred in Hartfall's material. Milder anaemias were found by a number of authors. Purpura was present in nine cases of the series of Hartfall, Garland, and Goldie, of which three were fatal. A fatal case of aleukaemic purpura (aplastic anaemia) was described by Parr and Shipton. These authors saw among fifty cases five hemorrhages from the uterus, bowels, and lungs.

Griffiths and Race observed both punctate basophils and polychromatic cells in sixteen (76 per cent.) out of twenty-one cases treated with gold salts. The gold preparations used were sanocrysin and myocrisine. Of the nine patients treated with myocrisine, all showed polychromasia and punctate basophilia. Hartfall and his co-authors failed to find basophilic stippling in their cases, and they were not noted in our blood counts. Eosinophilia exceeding 5 per cent. was also absent in our series.

No cases of jaundice occurred in our patients. Jaundice is a complication which has been seen occasionally by a number of authors. Hartfall, Garland, and Goldie reported an extremely high incidence of eighty-five, or 9.4 per cent. It is remarkable that no cases of jaundice occurred among their first 100 patients, when they gave larger doses. Myocrisine gave the highest percentage (11.9 per cent.) of jaundice. These authors point out that the results of treatment were worse in the cases with jaundice. Immediate reactions were not observed in our series. Rare cases of anaphylactic shock with pulmonary or laryngeal oedema, nausea, vertigo, and vomiting, and asthmatic attacks were previously observed.

No mortality was encountered in our series. Among their 900 cases, Hartfall, Garland, and Goldie reported ten deaths, an incidence of 1.1 per cent., which they attributed to gold. Three of these cases can be deducted, as the cause was unknown, which would reduce the mortality to 0.78 per cent. In the first series of 100 cases, the mortality was 3.1 per cent.; in the second series, 1.3 per cent. Parr and Shipton had one death in seventy cases; Forestier, only one in 550.

## EVALUATION OF THERAPEUTIC RESULTS

The difficulties of the evaluation of therapy in any disease are greatly increased in the case of arthritic affections. The etiological factors vary greatly and as yet are not entirely known. The duration and intensity of activity are subject to extreme fluctuation. The transitory pains in muscular rheumatism and the effusions in acute rheumatic fever may last only a few days or weeks, while the periarticular and interarticular changes in rheumatoid arthritis or osteo-arthritis may persist for decades. It is evident that by indiscriminate selection of material and by inclusion of many mild forms, improvement may be shown in a high percentage of cases with any type of treatment. This procedure is deceiving, because the severe forms are the real proof of the value of the treatment.

A critical and conservative evaluation should be based on the following principles:

1. The course of the type of arthritis under treatment should be prolonged, and spontaneous remissions should occur only in a small percentage. This requirement was fulfilled by the authors, who have concentrated their investigation on the action of gold salts in the rheumatoid type of arthritis.

2. The material for evaluation should be selected from cases which are active and of long enough duration to safeguard against the possibility of giving credit to the therapy for spontaneous remissions. The bulk of the material published by the European authors satisfies this requirement. In our own material we have eliminated all cases of less than one year's duration.

TABLE VII  
RESULTS OF GOLD THERAPY IN RHEUMATOID ARTHRITIS

Authors	No. of Cases	Cures or Marked Improvement (Per Cent.)	Not Improved (Per Cent.)	Observation Period (Years)	Relapse after One Course (Per Cent.)	Deaths
Forestier.....	550	64.0	8.0	2 to 7		1
Hartfall, Garland, and Goldie.....	690	66.7	14.1	1 to 5	13.2	7
Copeman and Tegner	51	58.0	6.0			
Crosby.....	27	33.3	14.8			
Parr and Shipton....	70	57.0	20.0		2.3	1
Pemberton.....	69	56.5	11.5			
Sashin, Spanbock, and Kling.....	80	43.7	17.5	1 to 5	10.4	
	1537	54.1 (Average)	13.1 (Average)			9 (0.58 per cent.)

3. The inefficiency of previous treatment is a valuable control of favorable results after initiation of gold therapy. In the majority of cases reported by various authors the patients had received other treatments before gold therapy. This applies to our material also.

4. Permanency of the results should be ascertained by prolonged observation. The incidence of relapse should be carefully noted. This also was carried out by most authors.

5. Decisive for evaluation of efficiency are only the percentages of cures or marked improvement with great relief and increase of activity. Table VII presents a compilation of the results of gold therapy in 1537 cases of rheumatoid arthritis. Consideration of slight improvement was entirely eliminated. The average percentage of cures and marked improvement was 54.1. The minimum was 33.3 per cent., and the maximum was 66.7 per cent. in the large series of Hartfall, Garland, and Goldie. Forestier had nearly as good results,—64 per cent. in his most advanced cases. In our own series the percentage of marked improvement was 43.7. The duration of observation after treatment was from one to five years and even up to seven years in Forestier's cases.

In a control series of 120 cases which were treated by various other methods—including vaccines, high-vitamin diet, and chaulmoogra oil—improvement of equal degree was exhibited in not over 15 per cent. of the cases, and did not persist for such long periods.

The average percentage of non-improvement was 13.1, ranging from 6 to 20. Relapses were observed after the first course of treatment in 2.3 per cent. of the cases of Parr and Shipton, in 10.4 per cent. of our own series, and in 13.2 per cent. of the cases of Hartfall, Garland, and Goldie. The last-named authors found that the incidence of relapses was also high after the second course of treatment,—12.9 per cent. However, in subsequent courses there was a rapid decrease of relapses to 2.2 per cent.

Table VIII illustrates the very significant fact that the percentage

TABLE VIII

RESULT OF GOLD THERAPY IN EIGHTY-EIGHT CASES OF RHEUMATOID ARTHRITIS  
IN RELATION TO ONSET OF DISEASE

Duration	No. of Cases	Marked Improvement (Per Cent.)	Slight or Moderate Improvement (Per Cent.)	Not Improved (Per Cent.)
Less than 1 year	8*	50 00	37 50	12 50
1 year . . . .	13	53 85	38 46	7 69
2 years	14	50 00	35 71	14 29
3 to 5 years	26	42 31	38 46	19 23
5 to 25 years	27	37 04	40 74	22 22

\* These eight cases of less than one year's duration have not been included in the study upon which this paper is based.



of marked improvement falls only very gradually with the increase in the duration of the disease before the initiation of gold treatment. In 53.85 per cent. of the cases with only one year's duration there was marked improvement. In the cases with duration of the disease from five to twenty-five years there was marked improvement in 37.04 per cent. Accordingly, the percentage of non-improvement rises very gradually from 7.69 to 22.22 in the corresponding groups.

The high percentage of marked improvement, the moderate occurrence of relapses, and the efficiency even after prolonged duration of the disease establish gold salts as a valuable treatment of rheumatoid arthritis. We concur with the opinion of other workers that it is superior to any treatment which we have to date. On the other hand, we cannot entirely share their optimism that early treatment with gold salts may completely eradicate rheumatoid arthritis. In eight cases with a duration of less than one year we had one failure (12.5 per cent.) and only four cases with marked improvement (50 per cent.). Copeman and Tegner, in fourteen cases of less than one year's duration, reported marked improvement in only 57 per cent., which did not exceed the percentage of improvement for the whole group of cases under five years' duration. Animal experiments have shown that gold is not efficient in acute infections. Lewy and Freund found gold therapy inefficient in acute clinical sepsis. The possible inefficiency in the acute stage, the considerable percentage of unsatisfactory results, and the occurrence of toxic reactions lead to the conclusion that gold therapy, while a decided step forward, is still not the ideal treatment for rheumatoid arthritis.

#### RESULTS IN OTHER TYPES OF ARTHRITIS

The greatest efficiency of gold salts has been observed in the rheumatoid type of arthritis, which affects the peripheral joints. In eleven cases of ankylosing spondylitis, which is generally regarded as a division of the rheumatoid type of arthritis, the results were less pronounced. Forty-five per cent. of the patients did not show any improvement. In eighteen cases recorded by Hartfall, Garland, and Goldie marked improvement was present in only 27 per cent., as against 66 per cent. in rheumatoid arthritis of the peripheral joints. Copeman and Tegner also reported bad results in three cases of ankylosing spondylitis. Forestier claims that gold therapy is indicated in all active cases of inflammatory arthritis of known or of unknown etiology. He includes gonorrhoeal arthritis, but Hartfall, Garland, and Goldie, out of six cases, had only one cure and two cases of marked improvement. With the development of the new methods of treatment by sulfanilamide and hyperpyrexia, there is no need for gold salts in gonorrhoeal arthritis. Forestier admits that in typical tuberculous arthritis, gold is of no value, but he recommends it in the treatment of the Poncet type of tuberculous arthritis. Our result in one case was poor.

It is interesting that Hartfall and his co-authors found gold therapy

of little value in the treatment of periarticular fibrositis. Of seventeen patients, none was cured and only two were markedly improved.

In sixty-eight cases of osteo-arthritis, marked improvement took place in only 15 per cent. In several of our cases we found it of little value.

#### CONTRA-INDICATIONS

As already pointed out, gold therapy is contra-indicated in the presence of manifest renal or hepatic disease, asthma, urticaria, diabetes, granulopenia, purpura, thrombopenia, and primary or severe secondary anaemia. Previous severe drug reactions and familial tendencies to allergic diseases are indications that the utmost care should be used.

#### COMBINATIONS WITH OTHER TREATMENTS

Twenty-three patients received various types of physical therapy, such as short-wave diathermy, ultra-violet and infra-red radiation, and histamine iontophoresis. These measures gave symptomatic relief, but the final results were not superior to those in the group which received gold injections only. Hartfall, Garland, and Goldie did not give any other treatment in their large series of cases. During the course, an analgesic—such as aspirin or sodium salicylate—or a mild hypnotic—such as one of the barbiturates—may be given. It has been pointed out that iron and liver extracts, high-vitamin and mineral diets, and cod-liver oil are useful. Hospitalization in special institutions would guarantee the most favorable conditions for treatment and observation. For lack of such institutions, we are forced to treat these serious conditions in crowded out-patient departments, with drugs which require constant vigilance. This again emphasizes the need for the creation of ample hospital facilities for arthritis, which was previously stressed by Kling.

#### SUMMARY AND CONCLUSIONS

1. Eighty patients with active, advanced rheumatoid arthritis, which was refractory to other therapeutic measures, received injections of gold salts. Thirty-five patients (43.75 per cent.) were markedly improved and thirty-one (38.75 per cent.) were moderately or slightly improved,—a total of sixty-six patients, or 82.5 per cent., who were improved to some extent. Fourteen patients (17.5 per cent.) experienced no improvement. Of eleven patients with ankylosing spondylitis, six (54.55 per cent.) were improved, and five (45.45 per cent.) were unimproved. The results of gold therapy in these cases were inferior to those obtained in cases of rheumatoid arthritis with involvement of the peripheral joints.

2. Local and systemic reactions occurred in nineteen (23.75 per cent.) of our cases. The commonest were pruritis, urticaria, and stomatitis. In three cases treatments were discontinued on account of severe reactions. In the others the reactions were mild, and treatments were stopped until the toxic symptoms cleared up, and were then resumed.

Severe toxic reactions, purpura, and death have been reported in the literature.

3. Gold therapy is contra-indicated in the presence of renal or hepatic diseases, asthma, urticaria, diabetes, pregnancy, granulopenia, purpura, thrombopenia, and primary and severe secondary anaemia.

4. Gold therapy is indicated only in cases of rheumatoid arthritis. The high percentage of marked improvement, the moderate occurrence of relapses, and the efficiency even after prolonged duration of the disease establish gold salts as a valuable treatment of rheumatoid arthritis. We concur with the opinion of other workers that it is superior to any treatment which we have to date. On the other hand, the considerable percentage of unsatisfactory results and the occurrence of toxic reactions lead to the conclusion that gold therapy, while a decided step forward, is still not the ideal treatment for rheumatoid arthritis.

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## EXPERIENCES WITH THE CORKSCREW BOLT \*

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Sufficient time has passed since the first application of the corkscrew bolt four years ago to justify a brief report of the author's experiences with it since that time. A description of the instrument and its aims has been previously presented<sup>1,2</sup> and will not be repeated in this paper.

The corkscrew bolt has now been used by the author in eighteen unselected, unimpacted, central fractures of the hip. Sufficient time has passed since operation in the first fourteen of these cases to consider results with reference to bony union. In ten instances, solid healing has been attained; and, of these cases, five have been followed for two years or more. There have been two deaths and two other failures.

A statistical study, however, is not the primary object of this report. In the early phase of development of a new instrument and a new technique, problems present themselves, which can with certainty be avoided in future cases, and statistics are, therefore, misleading. It is the writer's intention at this time, rather, to consider the difficulties encountered as well as the failures that have occurred, and to indicate the means that have been devised to avoid their repetition. An analysis (Table I) and illustrative roentgenograms of the successful cases are appended. They speak for themselves and require little elaboration in the text.

### INSERTION, AND REDUCTION OF THE RISK OF INFECTION

The technique of insertion has been considerably altered since the original procedure was described<sup>1</sup>. An unhappy experience with overwhelming wound infection followed by death in an early case indicated that the sterility of the fluoroscope room could not be trusted. It was, therefore, decided that this operation should be done in the operating room, where it is now performed under roentgenographic guidance. Regarding directional control, the usual anatomical method of guidance in the longitudinal plane has proved simple and satisfactory. The point of insertion is anatomically identified by the vastus externus ridge. The superficial landmarks of the femoral head permit its approximate identification. Any error, as revealed on the anteroposterior roentgenogram by a metal marker, is easily compensated for by a corresponding deflection of the instrument which is being inserted. Accuracy in the lateral plane, however, has until recently been the source of some difficulty.

### LATERAL CONTROL

In the early cases, the plan of internally rotating the leg from 20 to

\* Read before the Orthopaedic Section of the New York Academy of Medicine, December 16, 1938.

30 degrees and aiming the fixative device parallel to the table was used. The anteversion of the femoral neck proved too variable a factor, and results were not consistently accurate. A plan of lateral control, which has proved simple, safe, and time-saving, was then stumbled upon. Its simplicity is such that it must have been used before, yet the author has not seen it elsewhere recorded. Its safety with regard to asepsis depends upon the fact that the roentgen-ray tube remains above the hip joint in the usual anteroposterior position and is not moved for the duration of the entire operation. Likewise, the cassettes are all placed in the tunnel

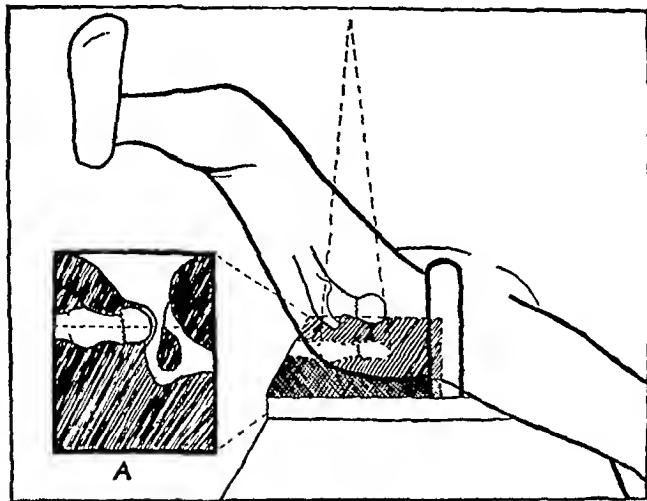


FIG. 1

The position for the lateral roentgenogram: full abduction, 90 degrees of flexion, 20 to 30 degrees of internal rotation. The lateral roentgenogram (A) shows the axis of the neck parallel to the base of the film.

degrees. Maintaining the same amount of internal rotation and with flexion at approximately a right angle, the thigh is swung into wide abduction, in which position the lateral roentgenogram is made (Fig. 1). Before the film is exposed, it is important to make

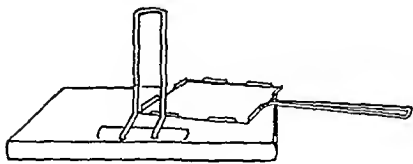


FIG. 2

Roentgen-ray tunnel with perineal bar.

sure that the roentgen-ray tunnel lies squarely across the table, since, if it lies obliquely, the resulting film will be misleading for our purpose. The rotary position of the patella and the femoral condyles is then noted and carefully maintained as the hip and knee are brought into full extension and traction is applied. When these manoeuvres have been completed, the usual anteroposterior study is undertaken.

The lateral film obtained by the technique described resembles the diagram shown in the insert (A) in Figure 1. We are chiefly concerned in this film with the relationship of the axis of the femoral neck to the

under the patient from the well side and remote from the wound. The method aims, by means of a lateral roentgenogram taken with the hip in flexion, to ascertain that the femoral neck will lie parallel to the table top when reduction is completed. The technique is as follows:

Reduction is accomplished in the usual manner with the hip in flexion, adduction, and internal rotation of about 25 de-

degrees. Maintaining the same amount of internal rotation and with flexion at approximately a right angle, the thigh is swung into wide abduction, in which position the lateral roentgenogram is made (Fig. 1). Before the film is exposed, it is important to make

sure that the roentgen-ray tunnel lies squarely across the table, since, if it lies obliquely, the resulting film will be misleading for our purpose. The rotary position of the patella and the femoral condyles is then noted and carefully

base of the film, since, when the leg is extended, the femoral neck will form the same angle with the table top. Generally, the plane of the femoral neck will lie parallel with the base of the film and, therefore, will lie parallel with the table top when the leg is in the position of extension. If, however, the plane of the femoral neck points upward or downward on the film, there are two possibilities: either (1) rotating or derotating the extended leg accordingly, or (2) aiming the fixative device in the plane indicated on the film. In either event, there is certainty that the vicinity of the center of the capital fragment will be penetrated. The use of this simple plan of lateral control entails no loss of time, for a lateral roentgenogram is always taken to check reduction. If care is taken to be certain that the roentgen-ray tunnel lies at an angle of 90 degrees with the axis of the table, the same exposure serves as a rough but entirely satisfactory lateral control.

#### THE ROENTGEN-RAY TUNNEL

The procedure has been greatly expedited by the use of a roentgen-ray tunnel with a perineal bar (Fig. 2). The perineal bar automatically centers the hip for both anteroposterior and lateral exposures and the small 8×10 cassettes may be used without risk of waste. Since 8×10 films are easily developed in trays, the rapid new thirty-second developing and fixing solution can be economically used.

The employment of the above technique has rendered lateral control simple and certain, and there has been no repetition of wound infection.

#### BLADDER INFECTION

The other death in this series followed gangrenous cystitis, multiple kidney abscesses, and sepsis traceable to a single postoperative catheterization. This case draws attention once more to the hazard of postoperative catheterization of elderly debilitated patients. Catheterization should be deferred until all conservative methods have been given painstaking trial. With the corkscrew bolt, the patient may be safely permitted to sit up out of bed on the first day after operation. The giving of a warm enema, occasionally the administration of pilocarpine, the use of the Credé method, etc., have eliminated the need for catheterization in subsequent cases.

#### THE METALLURGICAL PROBLEM

The two failures of this series (Cases 3 and 7) were directly attributable to the use of corkscrew bolts of improper metallic content. The importance of this seemingly small factor is illustrated by these cases.

CASE 3. M. L., female, aged seventy-four, was seen on December 4, 1935, with a typical intracapsular fracture of the femur. Reduction and fixation were performed without difficulty thirty-six hours after the fracture. At the time of operation there was no indication that a highly tempered experimental corkscrew bolt had been inadvertently placed in the operating set and was being used in this patient. After three weeks of uneventful convalescence, the hip suddenly became painful, and eversion and shortening



Fig. 3-A



Fig. 3-B



Fig. 3-C

Fig. 3-A: Case 1. R. D'A. A46M. Fracture, March 1, 1935.  
Fig. 3-B: Postoperative roentgenogram. Fig. 3-C: Three years and seven months after operation.



Fig. 4-A



Fig. 4-B



Fig. 4-C

Fig. 4-A: Case 2. I. W. A54M. Fracture, November 18, 1935.  
Fig. 4-B: Postoperative roentgenogram. Fig. 4-C: Two years and three months after operation.



FIG. 5-C



FIG. 5-B

Fig 5-A: Case 4 B N A71F Fracture, January 21, 1936  
 Fig 5-B: Postoperative roentgenogram Fig 5-C: Two years and two months after operation



FIG. 5-A

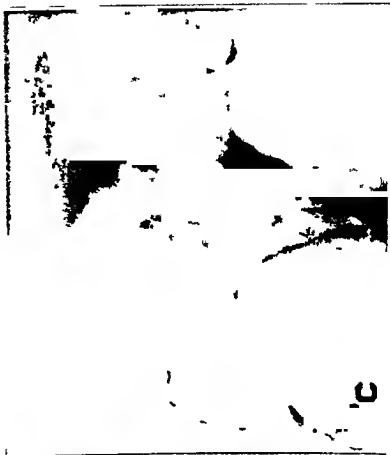


FIG. 6-C



FIG. 6-B

Fig. 6-A: Case 5. H. R. A78M. Fracture, February 12, 1936.  
 Fig. 6-B: Postoperative roentgenogram. Fig. 6-C: Two years and five months after operation.

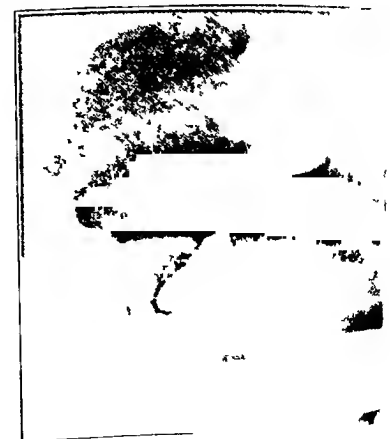






Fig 7-A



Fig 7-B



Fig 7-C

Fig. 7-A: Case 8 A S. A62F. Fracture, May 11, 1937.

Fig. 7-B: Postoperative roentgenogram Fig 7-C: Eighteen months after operation



Fig 8-A



Fig 8-B

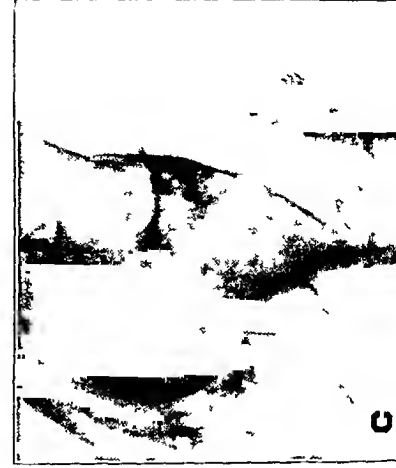


Fig 8-C

Fig 8-A Case 10 B S. A67F. Fracture, April 17, 1938

Fig 8-B Postoperative roentgenogram Fig 8-C: Four and one-half months after operation



FIG. 9-A

FIG. 9-B

FIG. 9-C

Fig. 9-A; Case 11. H. J. A61F. Fracture, April 23, 1938.

Fig. 9-B; Postoperative roentgenogram. Fig. 9-C; Four months after operation.



FIG. 10-A

FIG. 10-B

FIG. 10-C

Fig. 10-A; Case 12. A. G. A75F. Impacted fracture, February 8, 1938; separation of impaction, May 20, 1938.  
Fig. 10-B; Postoperative roentgenogram. Fig. 10-C; Four months after operation.

were noted. Roentgenograms disclosed that the screw had broken at the fracture site. The fragments of the bolt were removed with considerable difficulty as well as damage to the cancellous bone of the femoral head. Further treatment was carried out along different lines. The fragments of the screw removed at operation manifested extreme fragility, which was attributable to a very high temper.

CASE 7. D. A., female, aged fifty-eight, was seen on May 10, 1937. This patient had been a sufferer from severe rheumatoid arthritis of twenty years' duration and for

TABLE I  
ANALYSIS OF CASES IN WHICH SOLID HEALING HAS BEEN OBTAINED

Case	Sex	Age (Years)	Date of Injury	Date of Operation	Period in Bed	Weight-Bearing	Operative Comments and Complications
R. D'A.	Male	46	March 1, 1935	March 2, 1935	2½ months	4 months	Slight bend in bolt. Short plaster spica for 2½ months.
2. I. W.	Male	54	November 18, 1935	November 21, 1935	6 weeks	12 weeks	
4. B. N.	Female	74	January 24, 1936	January 24, 1936	4 weeks	3 months	Very poor lateral reduction in previously arthritic hip.
5. H. R.	Male	78	February 12, 1936	February 12, 1936	2 weeks	3 weeks	Mild psychosis of 2 week duration (confusion). Auricular fibrillation on fourth day after operation.
8. A. S.	Female	62	May 11, 1937	May 11, 1937	2 weeks	4 weeks	
10. B. S.	Female	67	April 17, 1938	April 23, 1938	4 weeks	6 weeks	Pernicious anaemia and schizophrenia with depression of 15 years' duration. Concurrent fracture of surgical neck of humerus.
11. H. J.	Female	61	April 23, 1938	April 23, 1938	2 weeks	4 weeks	
12. A. G.	Female	75	February 8, 1938	May 22, 1938	3 weeks	12 weeks	Operation 3½ months after injury due to separation of impaction. Severe arthritis 3 weeks after operation. Laparotomy with negative findings. Full recovery.
13. H. H.	Female	62	December 27, 1938	December 29, 1938	3 weeks		Slight coxa vara.
14. Dr. L. R.	Male	40	June 1938	January 7, 1939	1 week		

ten years had been almost a complete invalid. In a slight fall, she suffered a comminuted, severely displaced fracture of the right hip, the previous site of flexion-adduction contracture and marked limitation of motion in all planes. Roentgenograms showed a moderate degree of bone atrophy. With much difficulty the fracture was reduced and the fragments were fixed with a corkscrew bolt of stainless steel. This was the first and only patient in this group in whom a bolt made of this metal was employed. Metallurgical tests had indicated that the stainless-steel bolts were considerably softer than the tool-

TABLE I (Continued)  
ANALYSIS OF CASES IN WHICH SOLID HEALING HAS BEEN OBTAINED

Follow-Up Period	Complaints	Function	Shortening	Comments
Years, months	None	Slight limitation of internal rotation.	None	Working as a truck driver. No limp.
Years, months	None	Perfect	None	Walks without limp.
Years, months	None	$\frac{1}{4}$ normal motion	None	Patient entirely self-sufficient. Has no pain, but walks with marked eversion.
Years, months	None	Slight limitation of internal rotation.	None	Walks without limp. States hip has caused no trouble for over two years. X-ray shows some thinning of articular carti- lage.
Years	None	Perfect	None	Mild polyarthritis affecting many joints, but not hip operated upon.
Year, month	None	Perfect	None	No complaints referable to hip. No limp. Patient in home for mental diseases.
Months	None	Perfect	None	Walks without limp. No symptoms refer- able to hip.
Months	None	Perfect	None	Walks without limp. No symptoms refer- able to hip.
Months	None	Good. Abduction weak. Painless full pas- sive motion.	$\frac{1}{2}$ inch	Patient just commencing to bear weight.
$\frac{1}{2}$ months	None	Perfect	None	Walks well without pain and with slight limp, favoring the right leg.

steel ones used in the other patients, but it was considered sufficiently strong for the purpose. Roentgenograms, taken ten days after reduction, showed that the fragments had slipped. The cause of the loss of fixation was apparent when the screw was removed several days later. Due to the softness of the metal, the nut had stripped the thread on the shaft so that compression had been lost. Subtrochanteric osteotomy was then performed.

The mishaps in these cases were the direct result of employing high-tempered tool steel, which was too fragile, and stainless steel, which was too soft. In all but one of the remaining cases low-tempered tool steel was used, and it has proved to be entirely satisfactory. It is true that after the tool-steel bolts have been *in situ* for some time, a small area of rarefaction appears about them. However, as the roentgenograms show, they do not change their position in the hip, and healing has always been solid before the rarefaction is observed. There are no symptoms attributable to this rarefaction. Vitallium was tried in one case. It is entirely suitable, provided a bolt of the correct length is chosen for insertion, for vitallium cannot be cut with the clippers. The author has always regarded the ability to clip off excess shaft as one of the advantages of the corkscrew-bolt method, an advantage that must be sacrificed if vitallium is used. There is another disadvantage to vitallium. Instruments of this metal are all cast products and as such may possess flaws. It seems correct to state that the ideal metal for this instrument has not yet been identified, although tool steel of low temper has in the author's hands proved very satisfactory. When tool-steel corkscrew bolts are used, the importance of a correct temper cannot be overemphasized. The instrument must be firm, but must bend rather than break under stress. Too high a temper courts failure by cracking; too low, by bending, twisting of the shank, or stripping of the thread. Since an incorrect temper cannot be recognized on inspection, it is imperative that the instrument be of tested and reliable manufacture.

#### THE SATISFACTORY CASES

With the exception of the two deaths and the two failures recorded, complications of importance were not encountered in this group of cases. It is worthy of comment that the four failures were all recognizable during the early postoperative period. Conversely, all cases in which the first few weeks of convalescence were uneventful proceeded smoothly to bony union. In four recent cases bony healing has not yet been attained, but the clinical and roentgenographic progress thus far indicates that they will do as well as the earlier cases. Of the early cases, five have been followed for over two years. Thus far, necrobiotic changes in the femoral head have not appeared in any case, although in one (Case 5) the articular cartilage is thinned. The clinical course of these patients has been characterized by uniform smoothness. It is often impossible to determine the exact time of the occurrence of bony union, since the impaction obtained at operation obscures the fracture line in subsequent roentgenograms, and

since the injured hips are used freely and bear weight without pain long before bony union could be reasonably anticipated. In the early cases extreme caution was observed with reference to early weight-bearing. More recently, since the corkscrew bolt has proved its strength, greater latitude has been permitted. The strength of the fixation depends not only upon the instrument but also upon the density of the bone through which it is inserted, and generalizations are not applicable. Early weight-bearing has been allowed only in the presence of well-calcified bone.

In one case (Case 4), reduction was decidedly unsatisfactory, yet bony union occurred readily in spite of the malposition. Two other patients (Cases 12 and 14) were operated upon late (four and six months after injury), but this factor also appeared to cause no delay in healing. In one of these cases (Case 12) there was solid healing and the patient was entirely asymptomatic three and one-half months after operation, while in the other (Case 14), the patient is asymptomatic and healing appears to be progressing well.

In the author's opinion, these cases are noteworthy for the absence of many of the complications that have beset hip fractures treated with other fixative devices. In no instance has the corkscrew bolt "wandered" after its insertion. In no case has any perceptible shortening of the femoral neck occurred. In none of the five cases observed for over two years has any absorption or collapse of the femoral head been noted, although in one case (Case 5) there is some thinning of the articular cartilage. Moreover, there is no suggestion of these changes in any of the cases of lesser duration. Whether femoral-head changes will make their appearance in later years cannot yet be determined.

#### SUMMARY AND CONCLUSIONS

In recapitulation, eighteen consecutive unimpacted intracapsular fractures of the hip have been treated with the corkscrew bolt. Of the fourteen earliest cases herewith considered, bony union has been obtained in ten. As yet, no necrobiotic changes in the femoral head have appeared. The clinical course of these patients has been noteworthy because of the absence of complications that are not infrequent with other fixative devices.

Analysis of the failures reveals a clear cause for each of them that in future cases can be minimized or completely eliminated. The risk of death due to wound infection, as occurred in one case, should be greatly diminished by the use of the simple technique of insertion, including lateral control, which has been presented. Death due to cystitis and ascending infection should not occur again, since the danger of hasty catheterization has once more been demonstrated, and we have been able to avoid it in all subsequent cases by the careful employment of conservative stimuli. Moreover, there would appear to be no excuse for a recurrence of the two failures that were due to the use of corkscrew bolts of improper metallic

structure. The use of tool steel of low temper or vitallium appears entirely safe.

These experiences with the corkscrew bolt indicate its mechanical efficiency and justify its continued use. The causes of early difficulties have been identified and measures have been presented to diminish or to eliminate their recurrence.

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2. LIPPMANN, R. K.: Corkscrew Bolt for Compression-Fixation of Femoral Neck Fractures. *Am. J. Surg.*, XXXVII, 79, 1937.

# THE TREATMENT OF FRACTURES OF THE OS CALCIS

BY PAUL F. OLSON, M.D., DUBUQUE, IOWA

Fracture of the os calcis is a very disabling injury, due to the important rôle played by this bone in the mechanics of walking, and a proper restitution is very important to the future activity of the patient.

The methods advocated and employed in the treatment of this injury have ranged from simple immobilization to open reduction. No entirely satisfactory mode of treatment has yet been devised for those fractures that are comminuted into the joint. Simple immobilization is inadequate where there is consequential displacement. Manual reduction, followed by application of a cast molded to the contours of the foot, is not adequate for the impacted fractures. The two-pin method of Böhler, while admittedly not perfect, has been a distinct advance, and it is with a modification of this technique that the author has had success. The method herewith described gives accurate control of the replacement of the fragments, and the apparatus required is simple and can be quickly and easily assembled.

## TECHNIQUE OF REDUCTION

One Steinmann pin, three-sixteenths of an inch in diameter and seven inches long, is placed through the postero-inferior portion of the os calcis below the fracture (Figs. 1 and 2). A similar pin is placed in the anterior portion of the tibia above the ankle joint. It is important that the foot be held in dorsiflexion while the pins are inserted, so that the skin will not

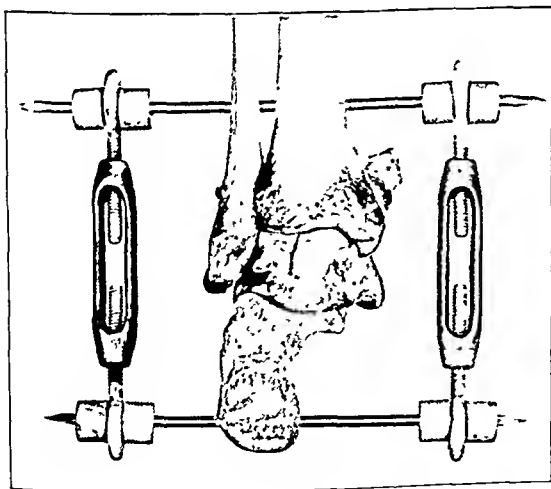


FIG. 1

Anteroposterior view of the technique of reduction as demonstrated on a skeleton.

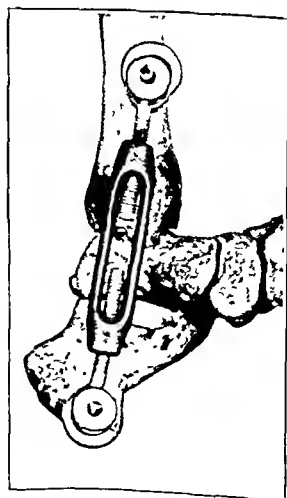


FIG. 2

Lateral view of the technique of reduction as demonstrated on a skeleton.



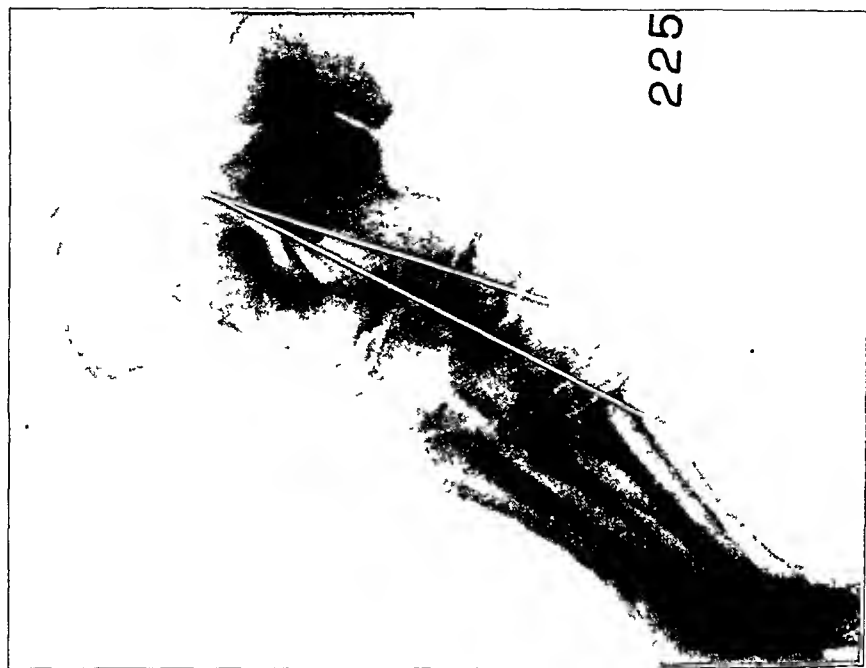


FIG. 3-A

Lateral view of a fracture of the os calcis before reduction. The lower portion of the bone is driven upward and forward, and the salient angle has been compressed to almost a straight line.

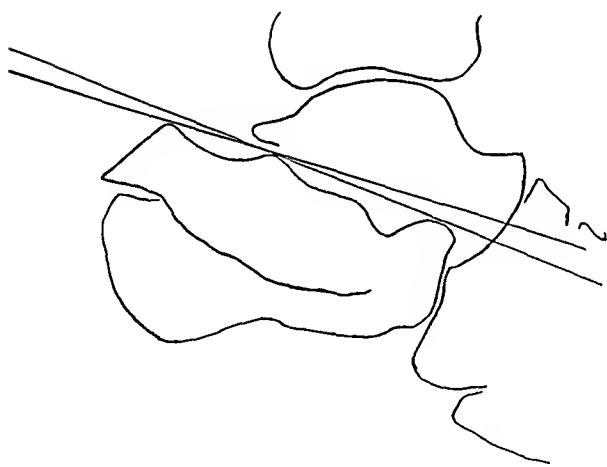


FIG. 3-B

subsequently be stretched. By means of two turnbuckles placed on the ends of the pins, pressure can be exerted on the lower pin. Placing shaft collars on the pins, one on each side of the turnbuckle, has proved to be a

great convenience in preventing the turnbuckle from coming in contact with the skin or from sliding off the end of the pin. Before placing the pins in the bone, one must determine the extent to which the lower part of the os calcis has been driven forward as well as upward (Figs. 3-A and 3-B). If it is desirable to force the lower fragment backward as well as downward, the lower pin should be placed well in the posterior portion of the os calcis and the upper pin as low and as far forward as possible in the tibia. By varying the position of the pins to meet the requirements of the case at hand, one can restore the contour of the os calcis (Figs. 4-A and 4-B). If the bone has been compressed directly upward, the line of

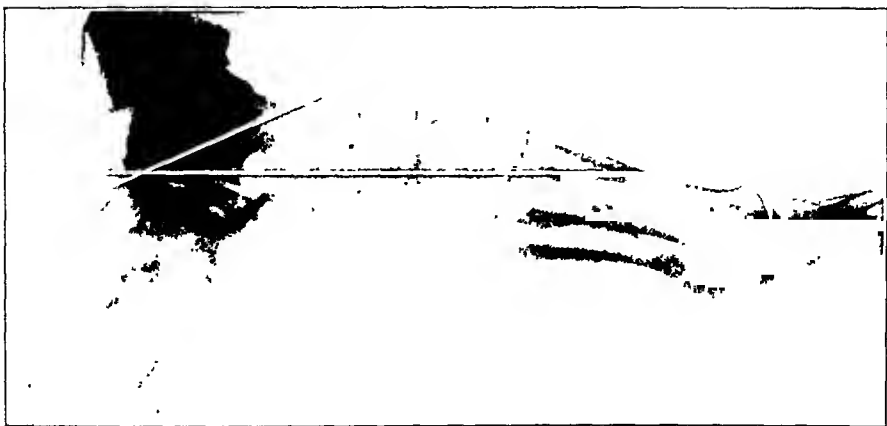


FIG. 4-A

End result. The contour of the os calcis has been restored, and the salient angle has returned to normal. There is still some decalcification in the bones of the foot.

force is to be almost directly downward. If the fragment has been driven somewhat anteriorly, the pins are placed so that the line of force is backward as well as downward. With the upper end of the turnbuckle braced against the pin through the tibia, elongation of the turnbuckles applies force to the distal fragment and accomplishes the reduction of the fracture. The reduction is carried out under general or spinal anaesthesia.

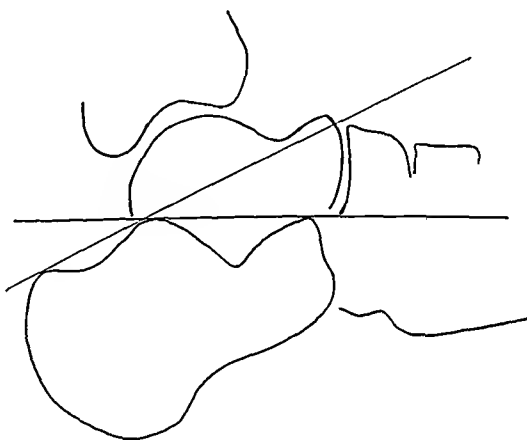


FIG. 4-B

In addition to the impaction of the fracture, there is also usually some medial or lateral deviation. This is overcome by exerting more pressure on one turnbuckle than on the other. In this important respect this method is superior to others usually employed.

The position of the bone during reduction is checked by roentgenograms, and force is applied until satisfactory reduction has been accomplished. In evaluating the exactness of the reduction, a roentgenogram of the normal os calcis is of inestimable value. When the salient angle of the fractured os calcis has been restored, so that it is comparable to that of the normal side, one can feel certain that the upward compression has been overcome. The reduction of the anterior and lateral displacements can be evaluated by comparison with the normal roentgenograms, and, by comparison with the prerduction films, the extent of the reduction can also be determined (Figs. 3-A, 3-B, 4-A and 4-B).

When satisfactory reduction has been achieved, the points of the pins are covered with corks, and the turnbuckles are incorporated in a plaster cast, which extends from the toes to the knee. A plaster cast may not be altogether necessary, but it has the advantage of solidly incorporating the turnbuckles, so that their adjustment will not be disturbed. The oedema that may be present about the heel and ankle presents no contra-indication to the cast, as both the turnbuckles and the plaster are at a safe distance from the skin (Fig. 1). The reduction may be made immediately after the fracture has occurred without waiting for the swelling to subside. Where the tuberosity of the os calcis has been displaced upward, it is well to extend the cast to the mid-thigh with the knee flexed, thus relaxing the Achilles tendon and minimizing any pull that might be exerted on the fragment.

#### AFTER-CARE

The patient is permitted to leave the hospital in five or six days, or as soon as the period of discomfort following the reduction has passed. Four weeks after the reduction, the cast, turnbuckles, and pins are removed and another cast, extending from the toes to the knee, is applied. At the end of six or eight weeks it is usually safe to add a walking-iron to the cast. One patient returned to his work as superintendent of a construction job as soon as the walking-iron was applied. After weight-bearing is permitted, the absorption of lime salts from the bone stops, and replacement begins. At the end of twelve weeks the cast is removed, and, if the roentgenograms show adequate union, the patient is permitted to return to walking with a shoe. The patient will feel more secure in a high shoe than in one of the oxford type. It is also important to equip the shoe with a metal and leather longitudinal arch support to distribute the weight, so that not too much is borne by the os calcis. The patient derives considerable comfort from such support.

Physiotherapy is instituted after the cast has been removed, as there may be oedema and fatigue at the end of the day. Hot foot baths, elevation, and massage are employed. The wearing of a semi-elastic bandage during the day helps to control the oedema. Strangely enough, there is very little limitation of motion in the ankle, although one might expect that the pull exerted across that joint during the reduction would cause subsequent discomfort. Where there has apparently been comminution of the fracture into the articulation with the cuboid, there will be fatigue and discomfort in the middle of the arch after the heel itself is solid and free from pain. This residual discomfort is probably best described as a traumatic arthritis.

#### ADVANTAGES OF THE METHOD

This modification of the Böhler technique was devised to meet the problems presented by two industrial cases in which the patients had sustained severe fractures of the os calcis. One patient returned to his ac-

customed employment in four months and the other in five months. There has been no permanent disability in either case. The results obtained have led the author to regard this method as an improvement in technique, having the following advantages:

1. The surgeon has more complete control over the reduction of the fracture, being able to overcome the lateral displacement (by adjusting one turnbuckle more than the other) at the same time that the fracture is being disimpacted and the fragments are being replaced downward and backward.

2. The apparatus can be incorporated in plaster, so that there is no possibility that the position of the fragments will be altered after reduction, as sometimes has occurred with the former technique.

3. The fracture can be reduced immediately without waiting for the oedema to subside, as neither the turnbuckles nor the cast come near to the skin in the region of the fracture.

4. Only a brief hospital stay is required.

5. The technique is simple. Fractures of the os calcis are not common and few hospitals are equipped to deal with them. The apparatus required for the method described can be assembled on short notice.

# INTERNAL-ROTATION-BRACE TREATMENT OF EPIPHYSEAL COXA ANTEVERTA (EARLY EPIPHYSEOLYSIS)\*

BY HENRY MILCH, M.D., F.A.C.S., NEW YORK, N. Y.

*From the Hospital for Joint Diseases †*

Epiphyseal coxa anteverta is the term which has been suggested to define the first stages of the condition which has been called separation of the upper femoral epiphysis or epiphyseolysis. The designation "epiphyseal coxa vara" is misleading and should, in the author's opinion, be discarded, because varus is a late and not a primary manifestation of the affection. Clinically, the first signs of onset of the disease are pain, limping, and then interference with function in the hip of adolescent individuals. Roentgenographically, the pathognomonic sign is a so-called "widening of the epiphyseal line". This has been reproduced experimentally and has been proved to be due to the forward turning of the upper end of the femoral neck. Because of the fact that the prognosis becomes materially worse, if treatment is undertaken late in the course of the disease, the necessity for early diagnosis and immediate emergency treatment, as for a fracture, has been stressed. Since these patients are seen first by their family physicians, the responsibility for early treatment must be placed squarely in their hands, if the hope of minimizing the disability is to be realized.

In the past, many different procedures for the treatment of epiphyseolysis have been attempted. In the author's opinion, some of these methods have failed either because they were not indicated for the particular phase of the disease or because they were not adequately designed to meet the requirements of the particular case. This is true especially of the brace treatment of the early stages of epiphyseal separation. Up to the present, the only type of brace prescribed has been the simple caliper walking brace, the primary purpose of which is to protect the epiphyseal zone from weight-bearing. This type of treatment, based on the concept that the condition is primarily a coxa vara, has proved useless, regardless of whether an ambulatory plaster splint or brace has been used.

The method of treatment here reported is designed only for early cases before complete separation has occurred, and it differs from other brace treatments in that it employs the brace to *prevent* external rotation and not to protect against weight-bearing. It was developed in consequence of certain considerations which were stated at greater length in earlier communications<sup>1,2</sup>. It was there emphasized that epiphyseolysis is characterized probably from the very onset of symptoms by an external rotation of the leg and a forward turning (a true anteversion) of the upper end of the neck of the femur beneath the capital epiphysis. It was further

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† Service of Harry Finkelstein, M.D.

stressed that the degree of so-called "widening of the epiphyseal plate" is an accurate guide to the degree of anteversion of the neck, and that the varus deformity is a relatively late sequel of untreated cases. The logical therapeutic deductions from these facts are: (1) the necessity for early diagnosis and (2) the institution of immediate treatment designed to correct or to prevent the further progress of the anteversion.

In the beginning it was believed that the anteversion already present could be overcome by manipulative correction. While this may be possible occasionally, it was found that the desired correction did not justify the risk of making the condition worse, and the manipulative treatment of the early cases was abandoned. The only alternative of a strictly non-operative nature was immobilization in a plaster-of-Paris spica. Although the value of this procedure was well recognized, it seemed desirable, if possible, to avoid the long period of bed rest with its attendant muscle and bone atrophy. The obvious solution of this difficulty was the use of the leg brace.

At first, a simple Thomas walking caliper, with a pelvic band, was used, but this did not seem to ensure maintenance of the internal rotation, and a small stabilizing cuff for the opposite or well leg was added (Fig. 1). The principles of this method have been employed in four cases. The first patient was treated as a test case three years ago. Further applications of the method were deferred, pending the outcome of this case. The successful result encouraged us to continue with the method. During the past year three additional patients, ambulatory except for a short period, have received treatment only by means of a brace.

The fabrication of a brace requires time, and time is of the utmost importance in the treatment of these cases. As the result of an inadvertent turn in bed or a misstep, a relatively benign case may be converted into a complete separation, with correspondingly poor prognosis. Consequently, during the period required for the preparation of the brace, all weight-bearing should be completely prohibited and the patient treated as an emergency case. If the patient can be placed in the hospital immediately, a simple plaster boot, with a cross-piece to maintain internal rotation, is applied (Fig. 2). A cross-piece nailed to the heel with the foot in internal rotation can be made to serve the purpose.



FIG. 1

Internal-rotation brace as at present used.



FIG. 2

Simple plaster boot, with incorporated cross-bar to maintain internal rotation.

flexion and internal rotation. A roentgenogram (No. 2-26996) was reported as showing "a slight downward displacement of the right capital epiphysis". However, when the roentgenogram was more carefully studied, it was noted that there was a disproportion between the long axes of the head and the neck of the femur, which merely simulated the appearance of a downward displacement of the capital epiphysis.

Although the patient was admitted to the Hospital for Joint Diseases (No. 55958) for drilling across the epiphyseal line, the Chief of the Service acceded to the suggestion that purely conservative therapy be attempted in this as a test case. The patient was consequently fitted with a simple Thomas walking caliper to which a pelvic band had been attached. Flexion and extension at the hip were permitted through a hinge joint. Internal rotation of the right leg was gradually obtained and maintained at about 80 degrees by constant adjustment of the brace. The heel and sole of the opposite shoe were elevated, and the patient was permitted to walk about after being discharged from the Hospital on November 18, 1935.

Shortly after application of the brace, all subjective symptoms disappeared, and the patient engaged in his normal activities with comfort.

Roentgenograms taken on March 2, 1936, seemed to show a reduction of the anteversion and a correction of the slipping. The patient felt so well that on June 1, 1936, he wanted to remove the brace. Although he was cautioned against this, he apparently disobeyed and, on June 24, 1936, he returned to the Clinic, complaining of recurrence of his symptoms. The brace was readjusted, and the internal rotation was increased. On July 14, 1937, a check-up roentgenogram (No. 2-36208) demonstrated "excellent alignment of the capital epiphysis, with some evidence of bone replacement through the epiphyseal line".

The patient then disappeared from observation until October 14, 1938. At this time he stated that he had discarded the brace, after wearing it for eight months. He had no complaints and stated that he had engaged in all the activities of his playmates, including football. Examination disclosed no difference in length of the legs. There was no limitation of motion in the right hip. Internal as well as external motion was completely normal. The patient could squat down and could abduct his legs almost to "do a split". The roentgenograms taken on November 5, 1935 and on October 22, 1938, were compared. On the original film there was a definite moderate slipping of the capital femoral epiphysis with the femoral shaft in moderate external rotation. The roentgenogram taken on October 22, 1938, disclosed no abnormality whatsoever. The capital femoral epiphysis appeared to be almost completely united to the neck in excellent posi-

If this is inexpedient, and if the treatment must be ambulatory, a full hip spica, with the leg in internal rotation, is applied before the patient is permitted to return home.

#### CASE REPORTS

CASE 1 (Partially presented in previous report<sup>1</sup>). A. M., male, aged eleven years, (Out-Patient Department No. 14489), was first seen on November 4, 1935, some two months after he had fallen and injured the right hip. He had been examined at another orthopaedic hospital and operation had been advised. Besides the evidences of a fairly typical endocrine disturbance, the physical examination disclosed pain on all motions of the hip, with the characteristic limitation of

tion. The upper quadrant of the femoral epiphysis appeared to be prolonged outward, in the form of a small triangular process, over the upper border of the femoral neck, to which it seemed to be uniting.

From the last roentgenograms taken, it was impossible to suspect the existence of the original abnormality. The epiphyseolysis appeared to be completely corrected.

The patient was discharged from treatment.

CASE 2. L. B., male, aged nine years, was first seen in the Out-Patient Department (No. J-7448) on July 2, 1937. It was stated that the child complained of pain in the right hip, which had come on one month previously, shortly after lifting a heavy weight. The patient was seen at another hospital, where he was told that nothing was the matter. The pain continued and, on admission, the patient showed some limitation of extension and rotation. Immediate roentgenographic examination (No. 2-36087) disclosed "early slipping of the femoral epiphysis on the left side, with beginning slipping on the right side". An internal-rotation brace and foot plates were ordered. Antuitrin injections were advised.

Apparently the brace was not supplied, because, on August 23, 1937, the patient returned, complaining of more pain. At the time it was observed that the child walked with a marked right limp. On the right side abduction was limited to 25 degrees. Internal rotation was possible only to the neutral position. The leg was normally held in about 10 degrees of external rotation, and rotation was possible to about 75 degrees. Flexion was possible only to 80 degrees from the extended position. This could not be performed in the mid-line and was possible only if the leg was externally rotated.

The patient was immediately measured for an internal-rotation brace and was then promptly immobilized, with the right leg in internal rotation in a plaster-of-Paris spica. Because of the absence of any symptoms on the left side, no treatment was given, despite the fact that the roentgenograms showed definite evidence of displacement. Shortly after the application of the brace in the early part of September, the symptoms in the right hip disappeared, but a roentgenogram (No. 2-37740), taken on November 1, 1937, showed what appeared to be an increase in the degree of slipping. This was very disturbing, but, on questioning the patient, it was learned that he was removing the brace during the night. This was immediately stopped, and the symptoms disappeared. With the brace, the boy was permitted to engage in all his normal activities. He was seen and examined roentgenographically at regular intervals. As late as June 1938, a period of almost nine months after beginning use of the brace, the epiphyseal line was still open and it was feared that recourse to drilling might be necessary. However, four months later, on October 10, 1938, a roentgenogram (No. 2-43327) disclosed "some evidence of fusion of the capital epiphysis to the femoral neck". Because of the absence of any symptoms and the patient's ability to move the hip in any direction without pain or limitation, it was decided to permit the patient to attempt going without the brace. Thus far no disability has developed. There have been no symptoms referable to the left hip.

CASE 3. M. C., male, aged fourteen years, was seen in the Out-Patient Department (No. J-11741) on November 3, 1937. For a period of three months following a "tug-of-war", the patient had noted pain in the left hip and intermittent limping. The patient had received no treatment prior to his appearance at our Hospital.

Examination disclosed a patient of typical pituitary development. On flexion of the right thigh to fix the pelvis, the left thigh could be extended only to 170 degrees. Flexion of the left hip was possible to 70 degrees, but only on external rotation of the leg. Abduction was slightly limited. As the patient lay on the examining table, the leg was held in 10 degrees of external rotation. From this point the leg could be internally rotated only to the mid-position, while external rotation was normal, as compared with the opposite leg. Roentgenograms (Figs. 3-A and 3-B), which the patient brought, presented the typical picture of an early epiphyseal coxa anteverta. An internal-rotation brace was immediately ordered. Within two weeks of application of the brace, the patient



noted complete subsidence of all symptoms. A roentgenogram (No. 2-39461), taken on February 23, 1938, disclosed "arrested slight epiphyseal slipping".

The patient remained under the care of his physician, and careful check-up roentgenograms were not obtained. However, the patient noted that he engaged in all the usual activities, without any symptoms. When he returned for examination in October 1938, the patient informed us that he had worn the brace until July, a period of about eight months. Since that time he had had no symptoms, despite the fact that he had continued without the brace. Examination disclosed normal flexion on both sides. Internal rotation was possible to about 35 degrees. External rotation was possible to 60 degrees, and abduction to 35 degrees (Figs. 4-A, 4-B, and 4-C). Roentgenograms (No. 2-43228), taken on October 7, 1938, were reported as showing "evidence of increased ossification at the epiphyseal line, as compared with previous plates". (See Figures 5-A and 5-B.)

CASE 4. G. R. (No. 69978), female, aged thirteen years, was admitted to the Hospital for Joint Diseases on April 18, 1938, complaining of pain and a left-hip limp. Although the history is a little confused, it appears that the patient had tripped on a rock, but had noted no pain until December 1937, following an appendectomy. The patient stated that the pain was most severe immediately upon arising from the seated position.

Examination disclosed a limitation of flexion at 105 degrees. This was possible only when the leg was externally rotated 20 degrees. Abduction was possible to 25 degrees, and internal rotation to 10 degrees beyond the mid-line position. External rotation was possible to 90 degrees. A roentgenogram (No. 61206), taken on April 19, 1938, disclosed a "moderately advanced slipping of the left femoral epiphysis".

The patient was measured for an internal-rotation brace and was then immediately placed in an internal-rotation boot. On April 25, 1938, the brace was applied and on May 11, 1938, the patient was discharged from the Hospital.

A roentgenogram (No. 61560), taken on May 4, 1938, was reported as showing "partial union of the capital epiphysis to the femoral neck". For several weeks the patient complained of pain, until the internal rotation was increased. On June 3, 1938, it was noted that the pain had disappeared. About ten days later the patient returned and stated that the pain had recurred when she removed the brace to take a bath. She was warned against the danger of removing the brace.

A roentgenogram (No. 2-41818), taken on July 11, 1938, a little more than two months after beginning the brace treatment, showed "almost complete obliteration of the epiphyseal line".

In September 1938, it was noted that there was no pain, and only slight limitation of internal rotation was present. In October 1938, the patient was again seen. Except for slight limitation of abduction on the left side there was an equal range of motion in both hips. The roentgenogram (No. 2-43149) showed "union of the capital epiphysis to the neck of the femur". The patient was advised to remove the brace at night and then gradually to remove it during her usual activities. The patient has remained free of symptoms to date.

The brace treatment here suggested is reported to permit wider trial of the method by the profession generally. It is hoped that in this manner a reliable experience will be gained in a short time.

In the four cases here described, healing occurred in one within two months; in two, within eight months; and in one, within the year. Whether the age of the patient influenced the time required for healing could not be definitely determined.

As a result of the injury to the epiphyseal plate, premature ossification of the epiphysis occurs, usually within eight to twelve months,



FIG. 3-B



FIG. 3-A

Case 3. Anteroposterior and lateral views, showing wide epiphyseal line and typical displacement of the epiphysis.



FIG. 1-A

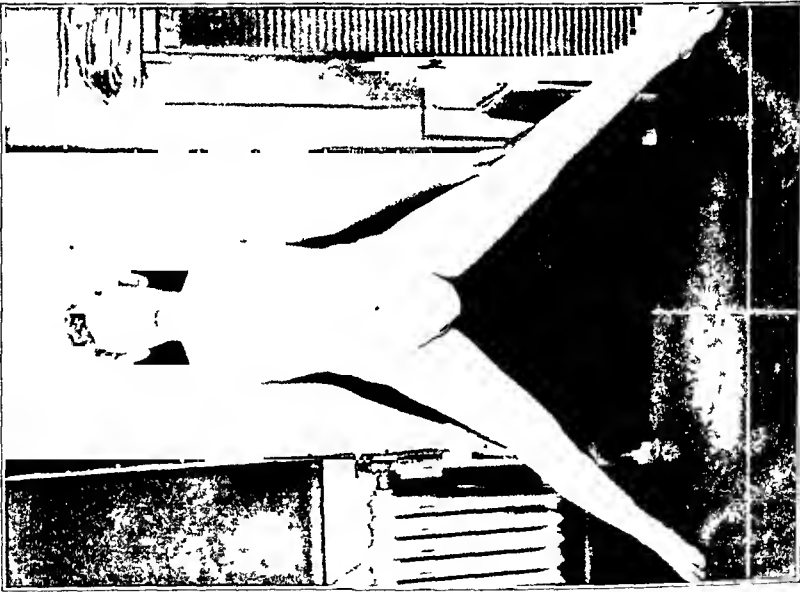


FIG. 4-B



FIG. 4-C



Case 3. Photographs of patient, showing typical range of motion after brace treatment



FIG. 5-B

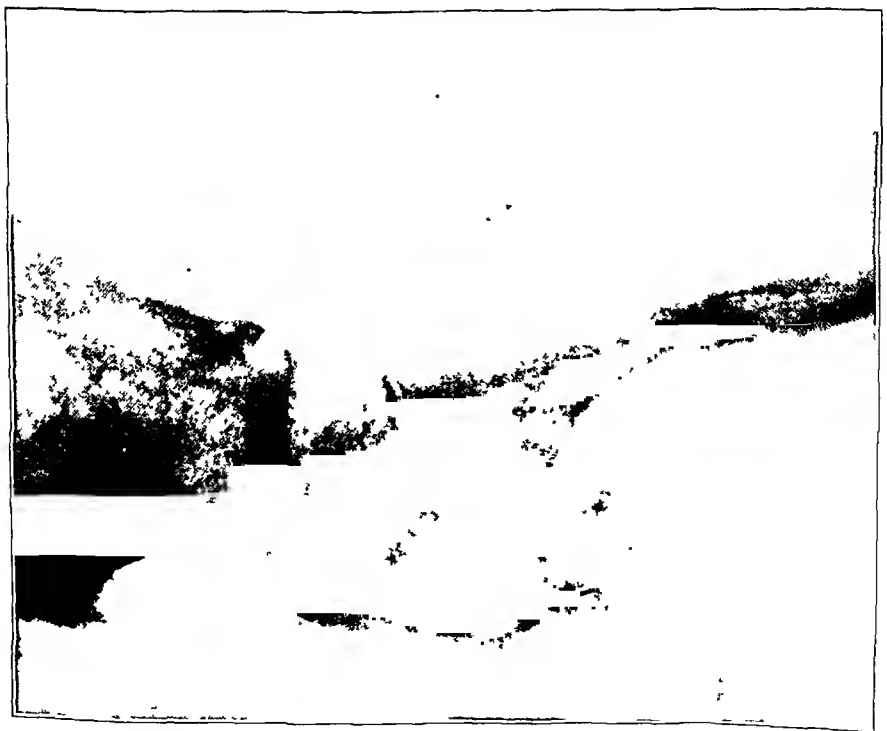


FIG. 5-A

Case 3. Anteroposterior and lateral views, showing early closure of the epiphysal line.

provided further slipping is prevented. The brace is worn until symptoms have disappeared and until the roentgenogram shows signs of obliteration of the epiphyseal line.

While it is true that by the method of drilling healing usually, but not always, occurs within three months, the brace treatment has certain marked advantages to offset the longer period of treatment required. In the first place, it puts the responsibility and the possibility for treatment directly within the hands of the medical practitioner. He is usually the first to see the patient and, with the roentgenologist, should be the first to recognize and to treat the condition in its earliest stages. It is only by means of this very early treatment that the problem can be ultimately solved.

An internal-rotation brace can be supplied to a patient anywhere by any competently directed brace maker almost as readily as in the large medical centers. The delay in time need not be feared, provided the patient's leg is freed from weight-bearing and is maintained in internal rotation, either by a plaster spica or by the internal-rotation splint. The brace obviates even the slight danger of operative approach or of postoperative infection. It can be applied in cases complicated by intercurrent illness or where the possibility of operation is precluded by the condition of the skin or by the more formal operative contra-indications.

The period of hospitalization is avoided or reduced to a minimum. The patient can be up and about, pursuing his normal occupations without danger and without loss. The expense to the family is almost negligible. When manufactured without a knee joint, the brace can be supplied for less than fifty dollars. With a movable knee joint, the cost is slightly greater.

#### CONCLUSIONS

The internal-rotation-brace treatment of epiphyseal coxa anteverta is suggested, because it appears to have given satisfactory results. It is recommended especially to the attention of the general practitioner, since it is he who first sees and must early diagnose the condition. The brace affords a ready, efficient, and inexpensive method of preventing a further progress of the lesion and of maintaining the position of the parts until complete healing has occurred.

In one or two cases the impression has been gained that the internal-rotation brace acts as a correcting force, tending to reduce the degree of anteversion present at the beginning of treatment.

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# CONGENITAL ABSENCE OF THE RAMUS OF THE MANDIBLE

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Congenital absence of the ramus of the lower jaw is rare. Modern textbooks on the surgery of the jaw ignore it entirely, and only a few isolated cases are to be found in the medical and dental periodicals. Considerable difficulty is encountered when one endeavors to review the literature, as the reported cases are described either under different titles, such as agenesis of the mandible, hypo-agnathus, and congenital dislocation, or in association with teratological subjects. For a true perspective of this particular congenital defect Ballantyne's review and discussion of mandibular anomalies is indispensable.

When absence of the ramus is bilateral, concomitant defects and malformations make the victim a notable monstrosity. One sub-variety of cyclops' monster also presents a complete absence of the entire lower jaw. The main object of this paper is to report five cases of congenital unilateral absence of the ramus, and to outline tentative methods of treatment.

## REVIEW OF THE LITERATURE

In addition to the five cases reported in this paper, nineteen cases have been found in the literature. The earliest case was described in 1827 by Dugès, the defect being on the left side. In 1861, Canton presented the case of a girl, aged sixteen, who died at Charing Cross Hospital, and on post-mortem examination an absence of the ascending ramus on the left side, with associated microtia, was discovered. Tomes in 1872 described a specimen of the jaw bone in which the development of the left ramus had been arrested. The horizontal ramus was no longer than that of a child of two years, although the other side of the jaw was fully developed. The author thought that some abnormality in the vascular supply might have brought about this condition, but he insisted on one point: the actual manner in which the growth had been arrested was the cessation of ossification in the articular cartilage.

In 1874, Alexander Ogston published in the *Glasgow Medical Journal* a series of articles on congenital malformations of the lower jaw, in which, in addition to two of his own cases, he reported an extensive description of a post-mortem examination in a case studied by R. W. Smith in 1847. The author called the condition congenital dislocation of the mandible, but the description and illustrations fit into the category of congenital absence of the ramus of the mandible. Kirmisson described a case in which, because of malformations of the mouth, the child could not nurse

well. The infant died from asphyxia at the age of two and one-half months. The right side of the face was less developed than the left, and, by palpation of the two sides of the face, it was discovered that the ascending ramus of the lower jaw was missing on the right side. The ear was also deformed. Bürger, Davis, and, more recently, Rocher and Fischer have described other cases.

The cases reported in the past, as well as those in this paper, show that unilateral absence of the mandible may be accompanied by defects of the external ear, macrostomia, and other cranial deformities. In less serious cases of mandibular deformities, such as hypoplasia of the jaw without bone defect, cleft palate has also been reported (Eley and Farber). This entire group of congenital deformities, from an ontogenic point of view, is the result of imperfect development or rearrangement of tissues in the first branchial arch and cleft. Defects in the first branchial arch are said to be found in lower animals such as the lamb, which is born at times with absence of the entire lower jaw (Ballantyne). In the literature on the subject, however, the matter of treatment has been entirely neglected. In the following report of five cases an outline of treatment will be given.



FIG. 1

Case I. F. T., at the age of four, showing hypoplasia of the right side of the face.

had fallen down a flight of stairs and, although confined to bed for a few days because of general bruises, she appeared to have suffered no other injury. The patient was born at full term in the home and weighed six pounds and eight ounces at birth. No history could be obtained as to the presence of infarcts or deformity of the placenta.

"When four months old, the baby was placed in the hospital because of malnutrition. At this point his weight was the same as at birth. Although the parents said that he had trouble in swallowing, no difficulty was found after he had been taken from the breast and put on bottle feeding. During this stay in the hospital, his general condition was studied by competent paediatricians and no disturbance other than the deformity of the head and malnutrition could be found. The latter apparently was improved by a suitable formula, for, at the age of one year, he weighed fourteen pounds and fourteen ounces.

\* Personal communication.

#### CASE REPORTS

CASE 1. F. T., a boy, was four years old when referred to the Massachusetts Eye and Ear Infirmary for treatment. (See Figure 1.) He was, however, first presented by Dr. Berry and Dr. Goodspeed at a meeting of the New England Otolaryngological Society in 1934, and he had been observed by these physicians practically from birth.\*

"The patient came from a poor Italian family. He had two older brothers—one six and one five years old—and a younger sister, aged two and one-half. There had been no deaths in the family, no miscarriages, and no stillbirths. There was no family history of any congenital deformity. The mother's blood Wassermann was negative. During the fourth month of pregnancy, the mother

"The right ear consisted only of a narrow piece of buried cartilage, one and one-half inches long and five-eighths of an inch wide, which protruded about one-fourth of an inch above the surface of the head. There was a small tragus, and posterior to this there was a small dimple, which appeared to be the external auditory canal and admitted a blunt probe for three-eighths of an inch. The normal ear was about two inches high and one inch wide. When the right mandible was palpated, the body could be followed backward to where one would expect the angle of the jaw to be, but no ascending ramus could be felt beyond this point. When the baby cried, the chin deviated to the right of the midline. There was no deformity on the left side, and no cleft palate or deformity of the nose was present. When the baby was seen at four months of age, no other abnormality was noticed about the face, but at one year of age the right upper jaw seemed to be smaller than the left. Roentgenograms of the skull, taken when the baby was four months old, did not show development of the mastoid cells or petrous portion as clearly on the right side as on the left. It was felt that a middle ear was present, although the semicircular canals did not show clearly in the roentgenograms. When the baby was one year old, gas-oxygen anaesthesia was given on two occasions to obtain pictures of the jaws. On the left side there could be seen the calcification center for the first and second permanent molars, which is early for this age. The roentgenograms also showed clearly the absence of the condyle and the ascending ramus of the right jaw."

This patient, now aged six, is at the present time under treatment at the Massachusetts Eye and Ear Infirmary for the reconstruction of the ear. No attempt has yet been made to repair the defect of the mandible. He is a healthy, good-natured child, and, aside from the distortion of the lower jaw and microtia, no other physical deformity is apparent. The permanent teeth are beginning to erupt in the regular time, but the occlusion is completely distorted.

CASE 2. L. B., female, aged ten years, was examined on June 3, 1935. (See Figures 2-A and 2-B.) She had congenital absence of the right ramus with marked asymmetry of the face. Most of the permanent teeth had erupted. The hearing was apparently absent on the right side, and the auricular canal was narrow on inspection. The bones of the face on the right side seemed smaller. The patient's left shoulder blade and the left foot seemed larger than their opposites. The child limped slightly because of the discrepancy in the size of the feet, according to the child's mother.



FIG. 2-A

FIG. 2-B

Case 2. L. B., on June 3, 1935, at the age of ten, showing external deformity of the right side of the face.





FIG. 3-A

FIG. 3-B

Case 3. D. P., on May 4, 1933, at the age of three, showing agenesis of the right mandible and microtia.

The roentgenographic report by Dr. A. S. MacMillan was as follows: "The ramus of the right jaw is not developed. There is not enough bone behind the second molar (which is well developed) to accommodate the lower right third molar. The glenoid cavity is undeveloped. The middle ear and the external and internal canals are apparently normal. The mastoid development on this side is rudimentary. The zygomatic arch is complete, but rather small. The malar bone and superior maxilla on the right side are smaller than on the left side. The scapulae on both sides are normal. The ribs on the right side are slightly higher than those on the left, and there is a greater space between the third and fourth ribs on the right side than on the left. The clavicles and the upper ends of the humeri are normal."

In this case it was decided that orthodontic treatment should be instituted as the first step. An attempt to expand the upper arch and to advance the mandible on the right side by appliances is at present being carried out by the child's orthodontist. The patient has not been seen again since her first visit.



FIG. 4

Case 3. D. P. Roentgenogram showing absence of the right ascending ramus.

side of the face. There was complete absence of the right ear, and in its place there were a few tags of ear tissue in the center of the cheek with a definite depression of the

CASE 3. D. P., male, aged eight, was first seen in 1931, when he was one year old. He was a well-developed child, with the exception of a conspicuous deformity of the right

mastoid, zygomatic, and temporomandibular regions. The child had a congenital fissure of the right corner of the mouth and this, combined with retrusion and deviation of the lower jaw to the right, caused a great distortion of the mouth. (See Figures 3-A and 3-B.)

The lower jaw was undeveloped, with complete absence of the right ramus and the zygomatic arch. The lower temporary teeth were beginning to erupt, but the occlusion of the teeth was very much disturbed, owing to the shifting of the mandible to the right. The left temporary cuspid tooth was opposite the upper centrals. The patient's head looked rather large, but, according to his parents, the child had never been ill. The roentgenographic report was as follows: "Total absence of the right ascending ramus, from the region one-half inch posterior to the first molar. Absence of the glenoid cavity and of the middle ear. The mastoid cells are undeveloped and the zygomatic arch is absent." (See Figure 4.)

Here again, the family history was entirely negative. At the present time the patient is eight years old. No attempt has been made as yet to correct the mandibular deformity. The reason for delay will be discussed later in this paper. However, the patient has been operated upon several times for correction of the macrostomia and the microtia.

CASE 4. M. A. B., female, aged three, was examined on November 1, 1935. (See Figures 5-A and 5-B.) She was found to have marked asymmetry of the face due to lack of development of the left side. The left external ear was entirely missing, except for a small anteriorly misplaced tag. The mastoid tip was undeveloped, and the zygomatic arch and glenoid cavity seemed to be absent. The neck of the condyle and the ascending ramus on the left side were missing. The horizontal ramus on the left side was short. There was no facial-muscle paralysis present. The roentgenographic report was as follows: "There is very marked asymmetrical development of the facial bones. The left petrous bone is incompletely developed. There are no mastoid cells and no roentgenographic evidence of a middle ear. The inner ear appears normally developed on both sides. There is asymmetrical development of the mandible, the left side being very incompletely developed. The glenoid fossa on the left side is undeveloped."



FIG. 5-A

FIG. 5-B

Case 4. M. A. B., on November 1, 1935, at the age of three, showing asymmetry of the face.

The author has not seen this child again and is unable to trace the case at this date.

The following case is the only one in which an attempt was made to reconstruct the mandible. The various procedures will be discussed in detail.

Case 5. D. M., male, was seen for the first time on June 8, 1933, at the age of seven years. The family history was negative. The parents, as well as a sister and a brother, were perfectly healthy and did not have any physical defects. As far as their



FIG. 6-A

Case 5. D. M., on June 8, 1933, at the age of seven, showing the distorted position of the teeth and marked deviation of the mandible to the left.



FIG. 6-B

Case 5. D. M., showing the facial appearance previous to treatment.

ancestors could be traced, there was no evidence of a similar deformity. Examination showed a well-developed child, mentally alert, and quite sensitive regarding the appearance of his face. Physical examination was essentially negative. The examination of the face revealed the following conditions: The left side of the face was undeveloped, and the left ramus was totally absent. There was no evidence of temporal, masseter, or pterygoid muscles, and there was no auricular canal. The external ear was a mass of folded tissue. The occlusion of the teeth was badly distorted, and there was a



FIG. 7

Case 5. D. M. Roentgenogram on June 8, 1933.

pronounced deviation of the mandible to the left (Figs. 6-A and 6-B). There was a linear scar about one inch long, extending from the left corner of the mouth horizontally backward toward the cheek. The patient was born with a congenital fissure at this angle of the mouth.

The following is the report of the roentgenographic examination by Dr. A. S. MacMillan: "Congenital anomaly of left temporal bone and ramus of left jaw. The mastoid process, the external canal, the glenoid cavity, and the zygomatic arch are absent. The squamous portion, the petrous pyramid—including the semicircular canals—the cochlea, and the internal auditory canal are normal. The mastoid cells, the antrum of the middle ear, and the contents of the middle ear are undeveloped. The first lower left molar is erupted. The crown of the second molar is formed, and there is enough space for the third molar, which is forming. The entire vertical ramus is missing. The left orbit is asymmetrical and slightly smaller than the right. The asymmetry involves the greater wing of the sphenoid on this side. The left malar bone and zygomatic process are smaller than the right." (See Figure 7.)

The hearing test was as follows:

<i>Right Ear</i>	<i>Left Ear</i>
20/25 Whisper . . .	0
20/35 Conversation.	0
23000 Upper Limit	0
64 Lower Limit	0
30/15 Rinne's Test	0

After careful study it was decided to start the surgical repair of the ear at an early date. In the meantime it was considered advisable to refer the patient to a competent orthodontist in his home town to see if it would be possible to correct the irregularities of the teeth, and perhaps to prevent further distortion of the mandibular and maxillary arches, with recommendations to expand the upper arch and to use intermaxillary elastics on the left side in order to retain the mandible at the median line. The orthodontic treatment continued for almost a year, resulting in quite satisfactory development of the upper jaw, but it was evident that the mechanical methods were not effective in controlling the lower jaw, which seemed to swing constantly toward the left. It was then decided to resort to other methods in order to prevent at least further distortion of the teeth and jaws.

The surgical treatment of this case consisted in reconstruction of the vertical ramus of the jaw and of the ear. Although the repair of these parts was carried out simultaneously, we shall omit discussion of the surgical problems associated with reconstruction of the ear and devote our attention to the mandible.

#### SURGICAL TREATMENT OF THE MANDIBLE

There were two methods under consideration: (1) construction of special appliances other than for regulating the teeth; (2) transplantation of bone to reconstruct the missing ramus.

1. Dental appliances for the control of the lower jaw in patients who have undergone operations for the resection of the mandible have been used satisfactorily by dentists in the past, as well as by the author. They are intended to transfer the function of the temporomaxillary joint from the region of articular eminence to a place distal to the last upper teeth. This is to prevent a backward swing of the jaw on the defective side of the mandible. The difficulty in making such an appliance for this patient was due to the fact that his permanent teeth, which would serve as abutments, were not adequately erupted and could not be utilized for the

retention of an appliance strong enough to serve

2. Transplantation of bone presented some ( the first place the child had not acquired his full changes in the facial contour would be constantly taking side of the face was growing normally, but the development was obviously delayed for an unknown reason. It was questionable whether or not transplanted bone would keep of the facial bones.

The second difficulty was the uncertainty of being able to bone when only one end of the transplant would be in contact with the mandible. It is true that successful attempts to do this have been made in the past by Gillies and others in patients who had lost one

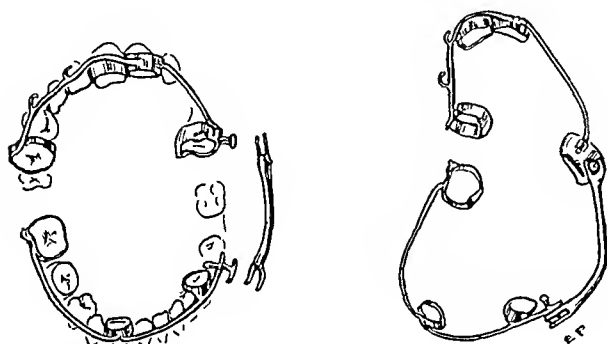


FIG. 8

Retention splint to steady and to maintain the mandible in its new position.

mandible, but did not possess a natural cavity. It was decided to reform the mandible by transplanting bone, and the following plan was adopted: A retentive splint was made and adjusted to force the lower jaw to the extreme right. This splint consisted of gold bands on the following lower teeth: two incisors, right and left temporaries cuspids. These bands were cemented together with a No. 18 gold wire. A gold button was soldered to the buccal side of the left cuspid tooth. Another appliance of similar design was fastened to the upper jaw. In this appliance the upper left second molar was banded also, and another button was soldered to the buccal aspect of this appliance. The appliances were cemented over the upper and lower teeth before the operation, and, while the patient was under anaesthesia, the lower jaw was forced to the extreme right and held in that position by a stout gold wire with a fork of more flexible wire at each end. These forks fitted into the gold buttons above and below (Fig. 8). This appliance steadied the mandible and immobilized it in its new position, a fact which greatly facilitated the subsequent operation.

Our plan was to connect the transplanted bone to the temporal bone above and to the mandible below, and to create bony ankylosis, to be followed later by an arthroplasty. This plan worked quite successfully as will be seen.

At operation (Fig. 9), on November 19, 1934, under avertin and ether anaesthesia, an incision about one and one-fourth inches long was made below the border of the left mandible, near the angle of the jaw, and the buccal aspect of the jaw was exposed as far back as possible. Another

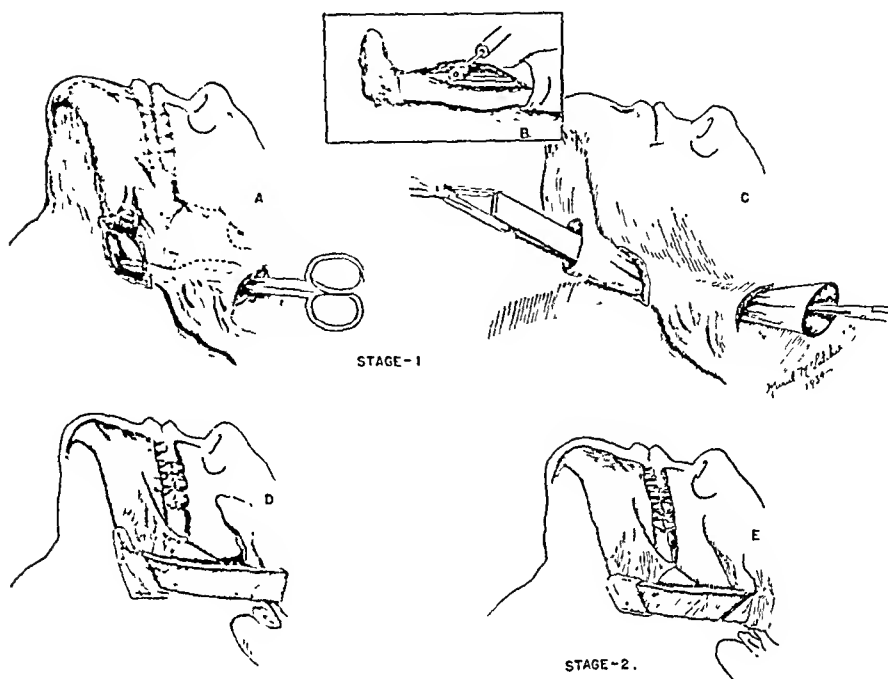


Fig. 9

## First stage of operation:

- A: Tunnel between the incisions;
- B: Tibial transplant;
- C: Transplant in position.

## Second stage of operation:

- D: Transplant in contact with temporal bone above and mandible below;
- E: Section at upper end of transplant to create new joint.

incision about one inch long was made over the temporal area, and the temporal bone was exposed. With a blunt instrument, tunneling was done until communication was established between the upper and lower incisions. The bone surfaces were freshened by removing a thin shaving with chisel and rongeur. A piece of tibial bone—about four inches long, one-half an inch wide, and over one-quarter of an inch thick—was then removed from the upper anterior surface of the tibia. The transplant was passed through the entire length of the tunnel from the lower incision until it fitted firmly into the temporal bone above and the mandibular bone below. An osteoperiosteal graft was inserted along the lower border of the mandible as far back as possible. The incision wounds were sutured, and a pressure bandage was applied.

When the patient had recovered sufficiently from the effects of the anaesthesia, the upper and lower jaws were fastened together by twisting flexible wires around the dental splints. He made an uneventful recovery and was discharged from the hospital on December 8, 1934.

From the date of the operation until after the second operation, the patient lived on a liquid diet. He gained in weight and did not seem to suffer any hardship from having the jaws wired together.



FIG. 10

Case 5. D. M. Roentgenogram showing the transplant seven weeks after operation. Note bony union at each end. Also shows the splints in position.

With a blunt instrument, the subcutaneous tissue was carefully separated, and the upper end of the bone transplant was exposed freely. After the bleeding had been controlled, a good-sized dental burr was used to cut through the transplant at about the level of fusion with the temporal bone. The cut was made diagonally downward and backward (Fig. 9, *E*). In addition, the skin over

X-ray examination on January 31, 1935, showed no absorption of the transplant. Moreover, bony union was complete at each end of the transplant (Fig. 10).

The second operation was performed under avertin-ether anaesthesia on February 2, 1935, seventy-five days after the first operation. An incision was made in front of the left ear, following the old scar line for about one-quarter of an inch. With a



FIG. 11-A

FIG. 11-B

Case 5. D. M., after operation, showing improved occlusion of the teeth and facial contour.

Fig. 11-A: December 17, 1934.

Fig. 11-B: April 18, 1935.

the ramus was undermined quite freely. A strip of fascia lata and fat, about three inches by one inch in size, was removed from the left thigh. One piece about one inch square was wedged in the fissure just made by the burr, while the other piece, which was larger, was spread under the skin over the ramus in order to give greater fullness to the face. The wound was closed with silk, and a pressure bandage was applied.

The patient has been under constant observation. The operation was quite successful in several respects (Figs. 11-A and 11-B). There is marked improvement of the facial contour, although it must be stated that complete symmetry of the face has not been achieved; this was not expected, however, as the underdevelopment of the left side of the face was not wholly due to the absence of the ramus of the mandible. The patient has full control of the jaw, except that the newly formed joint has not the same gliding action as the normal joint.

#### DISCUSSION

Although the immediate effect of the operation is gratifying, it is too soon to make any predictions of the eventual outcome in regard to the development of the left side of the face, but one can see possibilities for further operations in the form of bone, cartilage, or fascia transplantations, in order to give better symmetry of the face.

While this case shows an encouraging result in supplying the missing mandibular section by the transplantation of bone, yet it does not seem to the author altogether satisfactory. First of all, there is definite lack of normal development of the existing part of the mandible on the affected side, and, as the child grows older, this will appear more and more marked. Second, early treatment by transplantation of bone by the method described is not practical in young children. As a result, the delay causes definite malocclusion of the teeth, which is particularly noticeable in the upper arch. Mechanical devices to control the normal movements of the mandible have their difficulties also, on account of the age of the patient and the gradual replacement of the temporary teeth with permanent ones.

Transplanted bone and arthroplasty give good functional results, but grafted bone is not expected to grow in size or to cause improvement of the facial contour.

However, from the experience gained in the treatment of unilateral deformities of the mandible of acquired origin, it may be stated that as soon as a child with such a deformity reaches the age of twelve or over, and when all the permanent teeth (except the third molars) have erupted, it is possible to do osteoplastic operations, combined with dental and orthodontic treatment, thus improving the general facial contour of the patient.

#### SUMMARY

Unilateral absence of the ramus of the mandible is a rare deformity. It represents a clear-cut defect, which has been described under a variety of titles, thus making it difficult to discover in the literature. It is very



often associated with microtia (in four out of the five cases here presented) and at times with unilateral fissure of the mouth (in two of the present group of cases).

Embryologically, this defect is thought to be caused by improper development of the various elements of the first branchial arch and cleft. Other facial and cranial bone anomalies, however, are present rather often, especially in the temporal bone. The question may be raised whether these anomalies are not secondary to the absence of the mandibular segment, which thus deprives the surrounding tissues of a normal growth stimulus.

The five cases reported here have been collected over a period of the last eight years. Their treatment in general has been conservative, except in the case of the soft-tissue defects. The repair of mouth fissures and the building up of the ear when absent has not been delayed. The treatment of the mandibular defect is best postponed until the permanent teeth have erupted to permit the use of proper splinting and for other considerations outlined in the last case. Orthodontic measures, however, should be instituted early.

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# THE TREATMENT OF INTERTROCHANTERIC FRACTURES

BY WILLIAM P. BARTELS, M.D., HEMPSTEAD, NEW YORK

Forty consecutive cases of intertrochanteric fracture were reviewed in an attempt to determine the relationship of the treatment to the occurrence of union with or without a coxa vara deformity. These cases were treated at Meadowbrook and Nassau Hospitals during the past three and a half years. Only those cases were listed in which the fracture involved the region of the upper end of the shaft of the femur between the trochanters. Subtrochanteric fractures, pure basal fractures of the neck of the femur, isolated fractures of either trochanter, and pathological fractures were not included. No compound fractures were encountered.

In this series, the average age was a little more than seventy years, the youngest patient being thirty-nine and the oldest ninety-four. The history of injury given by most of the patients was similar to that obtained from patients with fracture of the neck of the femur. Following an apparently trifling misstep or slip, the patient fell, usually on the hip involved. However, we believe that most intertrochanteric fractures are due to torsion rather than to direct violence to the trochanteric area. This belief is based upon the absence of evidence of contusion of the hip region. Diagnosis was made from other fractures of the upper end of the femur by x-ray examination. When deformity was present, it consisted of shortening and eversion of the extremity.

In a series of forty cases of fracture with or without displacement, ten, or 25 per cent., of the patients died before union had taken place. One death occurred about two weeks after an attempted open reduction and fixation of the fracture. In the remaining cases we do not feel that any of the different treatments employed were responsible for the fatalities.

In all of the thirty surviving patients firm bony union was secured in from eight to sixteen weeks. In reviewing their roentgenograms, we separated them into two groups: (1) those showing no displacement; and (2) those showing displacement at the time of admission.

There were eight fractures without displacement. These in every instance united in excellent anatomical position. No coxa vara occurred. Five were treated by plaster spicas for eight weeks; two, by simple skin traction; and one, by Russell traction. It is apparent that coxa vara will not develop in this group without displacement if any simple protective therapy is employed.

There were twenty-two fractures with displacement. Five of these were treated by reduction under general anaesthesia and immediate immobilization in plaster spicas in wide abduction and internal rotation. A preliminary adductor tenotomy was performed in one instance. Immobilization was maintained from ten to twelve weeks, and, as far as we

could ascertain, none of the patients were able to become ambulatory without the aid of crutches. Final roentgenographic examination in every case showed union with coxa vara. Each patient had shortening of from one to two inches, and walked with a pronounced limp. The knee joints of these patients were particularly difficult to mobilize and remained a source of disability and pain over many months.

Three patients in this group with displacement were treated in Thomas splints with about ten pounds of skin traction for eight weeks. Ten pounds was all the traction that the skin of these elderly patients could stand during the time required for immobilization until union occurred. In these cases union occurred with marked coxa vara.

Twelve comminuted and displaced intertrochanteric fractures were treated by skeletal traction. In each case the extremity was installed in a Thomas splint with a Pearson attachment, and traction was applied by a Kirschner wire or Steinmann pin through the femoral condyles. From twenty-five to thirty pounds of traction was applied during the first week. This pull was decreased on the average to twenty pounds for the next seven weeks. These patients were encouraged to exercise the knee and to move about in bed as much as possible. The traction was discontinued and the pins were removed at the end of the ninth or tenth week, when evidence of good bony repair was found. In two cases, treated by skeletal traction, the weight was reduced to about ten pounds in the fourth week. In these cases union occurred with some coxa vara. A third patient insisted on leaving the hospital before union was firm and coxa vara resulted. In ten of the thirteen cases, union was obtained with a normal femoral angle and no shortening. In addition, only moderate limitation of motion of ankle and knee was present when traction was removed.

Open fixation was attempted in two cases of fracture with displacement. The Smith-Petersen nail and wire were used in an attempt to hold the fragments in position. The result in each case was disastrous. Because the comminution is considerably more extensive than the roentgenograms would lead one to believe, it is impossible to fix these fractures mechanically. In one of these cases, traction was again applied, and union occurred with a fairly normal angle. The other patient died some weeks after operation of sepsis due to infection of the wound. We do not believe that open operation has any place in the treatment of intertrochanteric fractures for the following reasons: (1) In fractures with displacement, open fixation will not maintain reduction. Traction is necessary to secure and maintain anatomical reduction. (2) In fractures without displacement, open fixation is unnecessary and subjects the patient to a needless risk.

Prolonged heavy traction is the key to reducing and maintaining the normal femoral angle in the intertrochanteric fracture with displacement. Other factors being equal, it seems that such fractures take about five to eight more pounds of pull than femoral-shaft fractures in order to maintain

reduction. This extra pull is needed to balance the tension of the gluteal-muscle group.

Treatment of the intertrochanteric fracture with displacement by the Hoke or Carl Jones well-leg type of traction was not done in this series. Theoretically, it should prevent the occurrence of coxa vara, as heavy traction can be maintained in an abducted position. This method has the definite fault of immobilization of the normal extremity as well as of the injured one. Muscle atrophy and joint stiffness in the normal extremity are additional disabilities, particularly at the time when ambulatory convalescence begins.

#### SUMMARY AND CONCLUSIONS

A review of forty intertrochanteric fractures of the femur was undertaken to determine the relationship of the type of treatment to the occurrence of coxa vara. The following conclusions were reached:

1. Intertrochanteric fractures without displacement unite without deformity, needing only simple protective treatment.
2. Reduction and immobilization in plaster with the leg in a position of wide abduction and internal rotation will not prevent union in a position of coxa vara, if there is displacement of the fragments.
3. Heavy skeletal traction, maintained until union has taken place, will adequately prevent coxa vara deformity. The pull must be from five to eight pounds more than that needed to control a fracture of the shaft of the femur.
4. Open reduction and fixation have no place in the treatment of intertrochanteric fractures.

# ISOLATED FRACTURE OF THE LESSER TROCHANTER

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Isolated fracture of the lesser femoral trochanter is a rare lesion; only seventy-eight cases have been reported in the literature since 1854. The lesion is a fracture of the femoral trochanter in the adult and an avulsion of the epiphysis in the adolescent.

## CASE REPORT

A. T., aged sixteen, a schoolboy, while attempting a high jump, felt a sharp pain in the right hip as he kicked his legs in the air. He fell and was unable to rise or to bear weight on the right leg. He was taken to the Metropolitan Hospital on April 7, 1938, with the diagnosis of a possible dislocation of the hip. The past history and family history were not significant.

Physical examination revealed a rather small boy of sixteen years, not acutely ill, and with a normal temperature. Flexion of the right leg on the thigh was exquisitely painful, but flexion of the right knee alone was not impaired. There was slight limitation of adduction and extension. No shortening or external rotation was noted. On palpation of the right thigh, deep-seated tenderness on the inner aspect of the hip was elicited.

Roentgenographic examination revealed a separation of the lesser trochanter with upward displacement.

Treatment consisted of twenty-one days of bed rest. The patient was up on crutches on April 28, 1938, and was discharged to the clinic symptom-free three days later. Roentgenograms taken at the end of the third and sixth months revealed bony union of the lesser trochanter with the shaft.



FIG. 1

Anteroposterior view of the right femur, showing isolated fracture of the lesser trochanter with upward displacement. Note presence of epiphyseal lines.

the cases, arises without aid. Since pain is experienced on the inner side of the thigh, he limps along with the hip rigid, swinging the injured leg before him. On examination, the patient complains of inability to flex the thigh. There is deep-seated tenderness in the region of the lesser femoral trochanter in Scarpa's triangle. Swelling and ecchymosis are rarely observed. Shortening is never found. External rotation, how-

## DISCUSSION

The syndrome of this isolated fracture is as follows: the patient falls to the ground, and, in 80 per cent. of

\* Anson H. Bingham, M.D., F.A.C.S., Director.

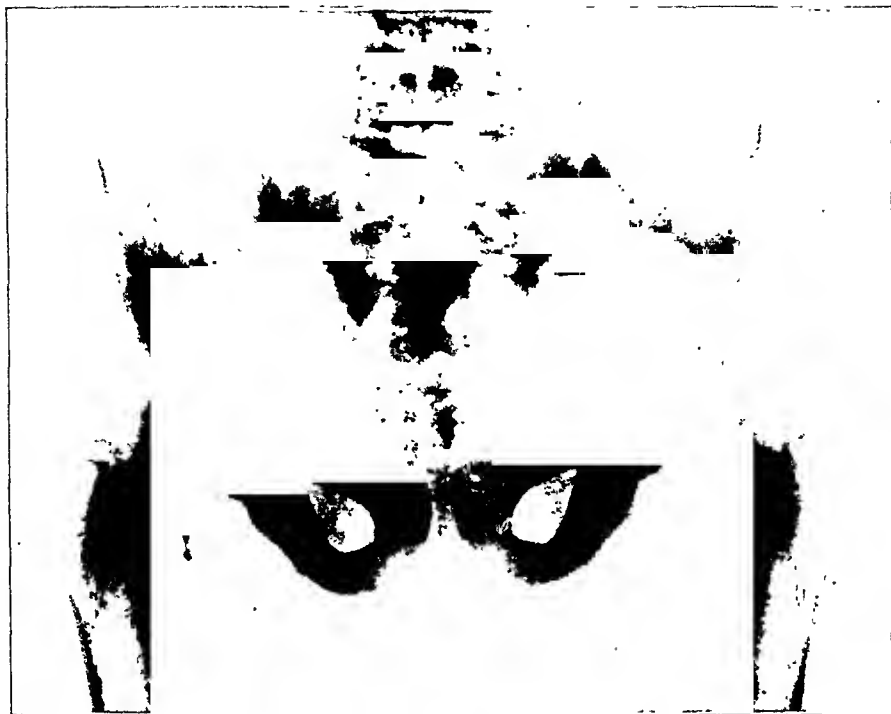


FIG. 2

Comparative view of both femora six months after injury. Ossification of the right lesser trochanter with the shaft is noted.

ever, is a common finding. Careful examination reveals free passive motion in all directions. The roentgenogram is taken with the thigh in external rotation. The lesser trochanter is avulsed and upwardly displaced. While this is the typical picture of an isolated fracture of the lesser trochanter, occasionally other variations will be found. The pain may, in some cases, radiate to the groin, flank, or hip joint.

Since 1854, seventy-eight cases have been reported. Of these, we have compiled and analyzed seventy-one. The other seven cases were not adequately worked up or followed. An analysis of the seventy-one cases reveals that 90 per cent. of the cases occur in adolescence between the ages coincident with the formation and ossification of the lesser trochanter. Only two cases have occurred in females, due to lesser muscular activity on the part of the adolescent girl. The right-sided lesion predominates over the left in the ratio of 3 to 2, because of the greater incidence of right-leggedness. Study of the etiology reveals that the patient is usually running or jumping or engaged in some form of sports. Only two cases were due to direct trauma. Forty-three per cent. of the patients were treated by bed rest alone; 34 per cent. were treated with a plaster spica with the thigh in flexion; 11 per cent. received traction; and 4 per cent. had open reduction. There is no evidence to the contrary that bed rest alone affords the simplest and best form of treatment.

# A CASE OF FREIBERG'S DISEASE TREATED BY A WALKING CAST

BY EUGENE L. JEWETT, M.D., ORLANDO, FLORIDA

Osteochondritis of the distal head of the second metatarsal is generally known as Freiberg's disease or infraction. This article merely deals with a form of treatment for this condition, and does not attempt to consider the etiology or pathology.

The recognized therapy for Freiberg's disease is some immobilization of the foot in splints or casts until the acute symptoms have disappeared, and then metatarsal pads or bars are applied to the shoes. Most authors state that ultimate resection of the head of the second metatarsal is necessary in order to cure the majority of these patients. However, the following case was successfully treated by a series of walking casts, which did not interfere with the child's going to school and carrying on her daily ambulatory existence.

## CASE REPORT

A normally healthy twelve-year-old child with a negative past history was seen by her paediatrician, complaining of pain in the left foot. She had injured the foot three



FIG 1

Anteroposterior and oblique-lateral views, showing the osteochondritic lesion in the distal head of the second metatarsal three months after injury.

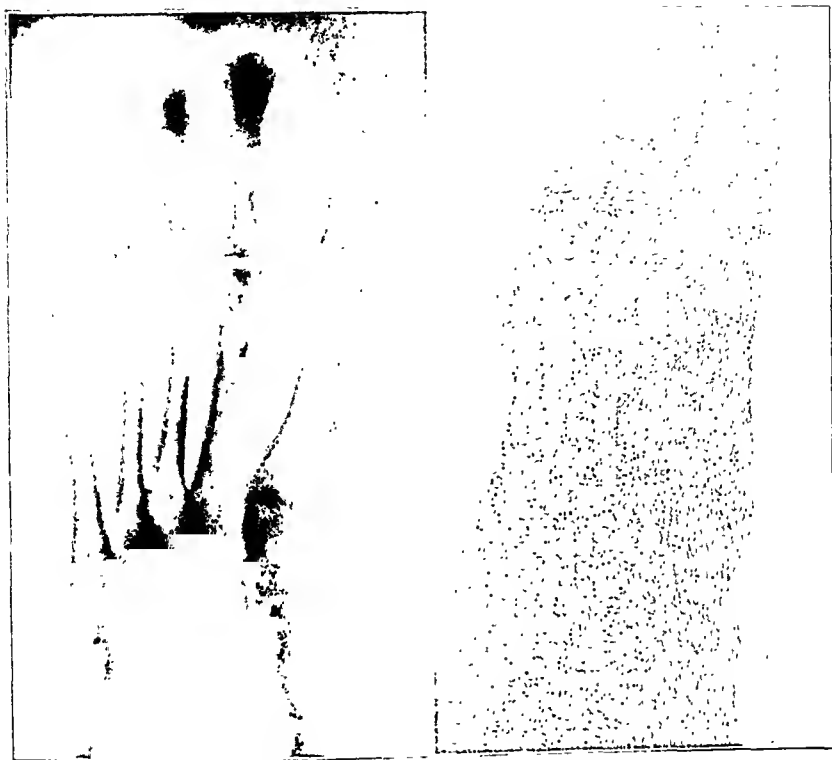


FIG. 2

Anteroposterior and oblique-lateral views nine months after injury and six months after walking-cast treatment had been instituted.

months previously while jumping, but it had not disabled or pained her very much during the interim. Some swelling and redness had been noted at times, with tenderness under the metatarsal region. Her doctor treated the condition as a mild rheumatic infection, but a few weeks' therapy with rest, hot soaks, and adhesive strapping were ineffectual in relieving the condition. When the author saw the patient it was about four months after the injury, and she had definite tenderness over the distal head of the second metatarsal of the left foot. There was a little swelling on the dorsum, and motions of that toe were painful. Figure 1 shows the condition, which is a typical picture of Freiberg's disease.

A felt pad was placed in the shoe, with a hole cut out for the involved area, but after a few days the pain still persisted. Therefore, the author applied a non-padded plaster-of-Paris walking cast, which the patient continued to wear with great comfort for six months. During this time the cast had to be renewed several times, but the patient continued to go to school without any pain and was even able to ride her bicycle. Figure 2 shows the practically healed condition at this time.

Casts were then discontinued, and, after a week or two of restricted activity, she resumed normal habits and has remained symptom-free for a period of over a year.

This method, the author believes, should be tried before any surgical intervention is attempted. The patient whose ease is reported has to all appearances a normal foot, which is usually not the case after a second metatarsal head has been resected.



# HABITUAL DISLOCATION OF THE DISTAL END OF THE ULNA

## REPORT OF A CASE

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The following case is reported because the method used in treating this habitually recurring anterior dislocation of the distal end of the right ulna has proved satisfactory and has not necessitated a mutilating operation.

### CASE REPORT

F. W. F., a soldier (Register No. 70330), was admitted to the Surgical Service of the Station Hospital, West Point, New York, on November 28, 1938. On January 7, 1938, while on duty at another post, his right wrist had been injured while lifting a floor-waxing machine. The styloid process of the right ulna had been fractured, and there had been a posterior dislocation of the distal end of the right ulna. These injuries had been treated by external splinting and physiotherapy until February 3, 1938, when the soldier was returned to a duty status. This man was transferred to an organization at West Point where he was required to do considerable manual labor.

On admission to the Hospital, he complained that lifting, with the right hand in a position of supination, caused the distal end of one of the bones at the wrist to jump forward, and this condition had become so frequent and annoying as to incapacitate him. Examination showed that the distal end of the right ulna was completely dislocated anteriorly when any force was exerted on the supinated hand. The dislocation could be readily reduced. Since this man is a soldier and a potential Government ward, it was desirable to cure his disability in some way that would not result in mutilation. Prior to operation, he was given a course of physiotherapy to tone up the muscles of the right forearm, which showed atrophy of disuse.

On December 17, 1938, under gas-oxygen-ether anaesthesia, the following procedure was carried out. An incision, approximately six inches long, was made along the ulnar border of the extensor surface of the right forearm, extending down to the base of the fifth metacarpal bone. The tendon of the extensor carpi ulnaris was identified and isolated from the point of its insertion to the beginning of the muscular portion. The distal end of the ulna was exposed. A tunnel, large enough to accommodate the tendon of the extensor carpi ulnaris, was drilled through the distal end of the ulna from above downward in a longitudinal direction. The tendon of the muscle was then sectioned obliquely well proximal to the wrist joint. The distal end of the tendon was threaded from below through the tunnel in the ulna, and the severed ends of the tendon were sutured with silk. The ligament over the posterior surface of the ulna was repaired, and the wound was closed. The wrist was fixed in a partial cock-up position with plaster-of-Paris. After six weeks, the plaster-of-Paris was removed, and a course of physiotherapy was instituted.

The soldier was returned to duty on February 20, 1939, and since that time he has subjected the wrist to an unnecessarily severe functional test. He has a full range of motion at the wrist; there are no subjective symptoms; and there has been no recurrence of the dislocation.

There has been no opportunity to use the principle of this method in a posterior dislocation.

# AN UNUSUAL LOCATION OF AN OSTEOCHONDROMA

## REPORT OF A CASE

BY MARTIN DOBELLE, M.D., PATTERSON, NEW JERSEY

*From the Orthopaedic Service of Sea View Hospital, Staten Island, New York*

The occurrence of osteochondroma is not uncommon, and any portion of the skeletal system may serve as a locus of origin for these growths. Despite the relative frequency with which these tumors are seen, their appearance on the costal surface of the scapula is altogether rare. A perusal of the literature revealed but four cases of this unusual location of an osteochondroma.

The first recorded report of scapular exostosis was that made by Adams in 1870 before the Pathological Society of London. He exhibited the tumor which had been removed from the scapula and which had projected beneath it and elevated it on the ribs. His report as to diagnosis was as follows: "It was taken for an enchondroma, but turned out to be partly bony."

In 1906, Goldthwait described the removal of a similarly located tumor.

McWilliams, in 1914, reported another such case and showed both the roentgenogram and a photograph of the specimen. It is of interest that McWilliams's specimen and that to be described here (Fig. 1) appear almost identical. His diagnosis was "an exostosis with adventitious bursa".

Two years later, Brown reported the removal of another such exostosis, but ventured no definite diagnosis. He stated that "it did not seem akin to the bone tumors". The site of the tumor which he excised was practically the same as in the present case.

## CASE REPORT

E. C., female, thirty-two years old, well-nourished and well-developed, a housewife, was admitted to the Orthopaedic Service of Sea View Hospital on July 22, 1938, for suspected Pott's disease of the second lumbar vertebra. Actually this proved to be an

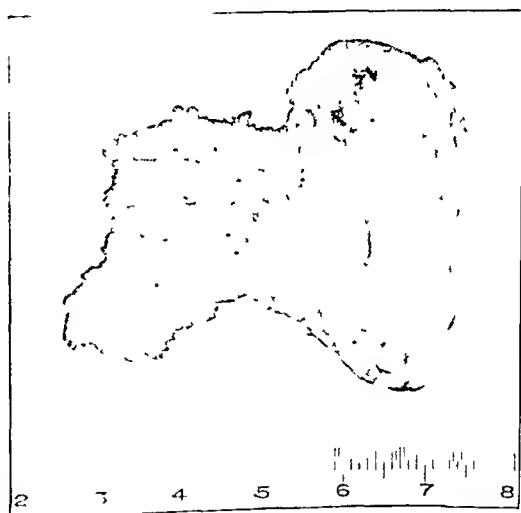


FIG. 1

Anterior view of osteochondroma.

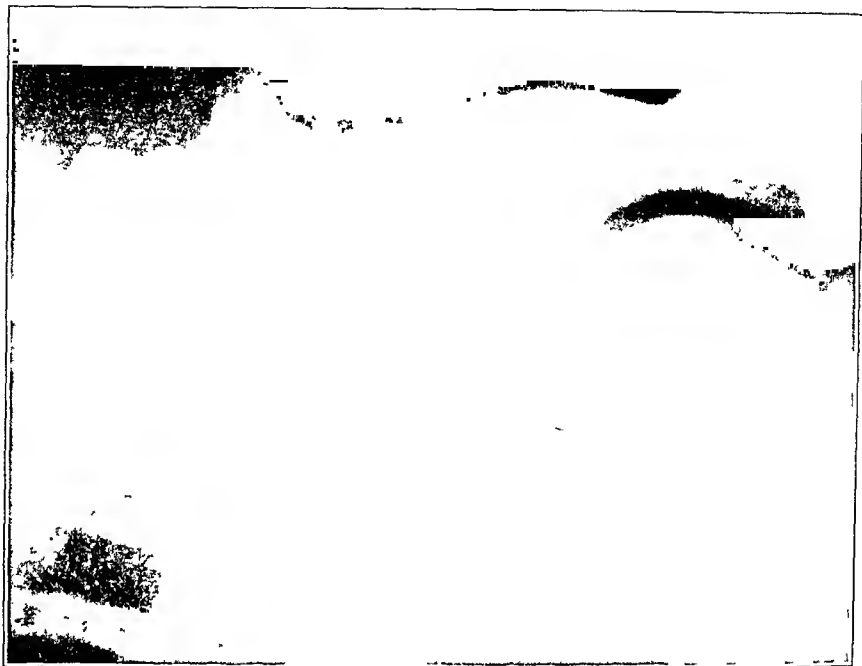


FIG. 2

Roentgenogram of right shoulder region. Note scapular growth and "moth-eaten" appearance of inferior surface of free end of exostosis. The actual specimen does not confirm this "fragmentation".

old compression fracture, and fusion of the first three lumbar vertebrae was performed on August 10, 1938. Routine roentgenograms of the spine and chest were taken eight weeks following this operative procedure, and, for the first time, a peculiar area of bone density of irregular contour, originating in the region of the right scapula, was noted. Further roentgenographic and clinical studies determined more accurately the position and relationship of the mass, which was on the superior costal surface of the scapula. Close questioning of the patient revealed that in the summer of 1936, while bathing at the seashore, her husband had noticed that her right shoulder blade was comparatively prominent and that on exaggerated movements of this shoulder a slight "grating" sound was heard; there was no interference with the free movement of the arm, nor was it in any way painful. During the past two years, this shoulder blade had become somewhat more prominent, and, although there had never been any pain, the "grating" sound was more audible with certain rotary movements of the shoulder.

No definite conclusion as to whether the growth was benign or malignant could be made, as is apparent from the "moth-eaten" appearance of the under surface of the free end of the exostosis (Fig. 2). Hence exosteotomy was advised and performed on November 20, 1938.

#### Procedure

A right-angle skin incision over the posterior superior border of the scapula was made. The trapezius muscle was split in its lateral oblique plane and retracted; the levator scapulae, the rhomboideus major, and a portion of the serratus anterior muscles were freed from their scapular attachments. Immediately superior to the rhomboid tubercle was felt a mass extending inferiorly and lateralward, entirely invested by subscapularis muscle. By means of an osteotome, the exostosis was fractured at a point about five-tenths of a centimeter from its base, and liberated with its base outward. A bursa could not be demonstrated. The wound healed *per primam*, and the patient made an uneventful recovery.



percentage of malignancy should make us wary of scapular tumors in general.

Honeij, studying the incidence of heredity of all reported cases of multiple cartilaginous exostoses, reported an apparent hereditary factor in about 50 per cent. In the author's case of a solitary tumor there was no traceable hereditary history.

The objective findings reported by Brown—"The scapula at times in sliding over ribs would catch and jump from one rib to another"—were closely paralleled in the writer's patient. However, in this case, although the tumor mass was larger, pain was never experienced during scapular movements, as noted by Brown.

Since it is entirely possible that an osteochondroma on the costal surface of the scapula may exist without any subjective symptoms and its peculiar location may mask its presence on physical examination, more of these cases may perhaps be found if the possibility of their existence is borne in mind.

The author wishes to thank Dr. David M. Bosworth for his kind cooperation in the preparation of this report.

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# DUPUYTREN'S CONTRACTURE OF PALMAR AND PLANTAR FASCIÆ

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*From Beth Israel Hospital*

In spite of the lapse of more than 100 years since Dupuytren first gave an accurate description of the gross pathology of the fascial contracture known by his name, surgeons and anatomists are as much in the dark as ever concerning the etiology of the affection. In the course of time many theories of causation have been advanced, but none of these could be reasonably maintained in the face of adverse clinical and experimental evidence.

The theory of repeated local trauma was first propounded by Dupuytren himself. The atavistic theory of Krogius is ingenious and plausible but it still lacks corroborative evidence. Stasis has been implicated by some, notably Ledderhose who offered some clinical and experimental evidence in support of his claim. Still others voice their belief in a so-called "fibroplastic diathesis", citing in support the coexistence of typical palmar Dupuytren's contracture with fascial contractures in other locations, such as the penis<sup>8</sup>, the plantar fasciæ<sup>9</sup>, and other structures.

More recently the neurologists, intrigued (as is everyone else) by the almost universal localization, at least initially, of Dupuytren's contracture in the ulnar portion of the palm, have sought to attribute the onset of the contracture to a lesion of the ulnar nerve. Gross injury to this nerve, however, as a factor in the production of contracture of palmar fascia had to be discarded after a careful study of World-War statistics, which showed a tremendous number of all sorts of ulnar-nerve injuries followed by an infinitesimal incidence of Dupuytren's contracture. Powers, therefore, uses a totally different approach. Because of its essentially hypertrophic character, this writer includes Dupuytren's contracture in the category of other hypertrophic conditions such as hypertrophic osteoarthropathy, scleroderma, rigidity of hypocalcaemic states<sup>7</sup>, hyperthyroidism, and various other hypertrophic intrathoracic and intra-abdominal affections. He believes that these affections produce irritation of the sympathetic ganglia with resultant trophic disturbances at the periphery (skin, aponeurosis, etc.), which he considers essentially similar. The close anatomical relationship between the thoracic sympathetic ganglia and the pleura and the ulnar nerve is extremely suggestive. The ulnar nerve arises from the eighth cervical and first thoracic roots, in closer connection with the intrathoracic sympathetic ganglia than other nerves of the brachial plexus, and Powers thinks that the ulnar nerve carries sympathetic fibers from these ganglia, although the existence of such fibers has

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admittedly not been demonstrated. He, therefore, advocates ganglionectomy as a therapeutic measure. Incidentally, he cites a number of cases of coexistence of palmar Dupuytren's contracture with aponeurotic contracture elsewhere in the body, nine of these being contractures of the plantar fascia.

Involvement of the plantar fascia, either alone or in association with contracture of the palmar fascia, seems to be of rather infrequent occurrence. Dupuytren, in his clinical lectures, mentioned a few cases. Auvray has also reported a case of bilateral contracture of the palmar and plantar fasciae. Both plantar surfaces had the same appearance as the palms: marked contracture of the fascia, with thickening and nodosity, adherence of overlying skin, and deformity of forefeet and toes. This author refers to a previously reported case of his showing unilateral contracture of the plantar fascia without palmar or other involvement. Kanavel, Koch, and Mason included two cases of podalic Dupuytren's contracture among a very much larger number of reported cases of contracture of the palmar fascia. They, too, stressed the infrequency of the plantar form of the affection.

#### CASE REPORT

A. M., male, aged forty, a Russian Jew, had a totally irrelevant family history. In his own past history the only significant fact was that he had sustained fractures of both tibiae and fibulae fourteen years previously. He had had several neisserian infections. He used to do heavy work in his youth, but, as his hands began to show increasing deformity, he had to resort to lighter work. In his left hand the thickening and contracture had begun about seventeen years previously, in the region of the little finger. The condition had progressed gradually, eventually involving all fingers including the thumb. In the right hand the deformity had begun about eight years prior to examination, and was also noticeably progressive. The thickening of the plantar fascia (in the right foot) was first noticed about fifteen years previously. It was moderate and not painful or disabling at first, but, as it increased, walking and weight-bearing became difficult. The patient was not quite certain whether the involvement of the sole of the foot preceded or

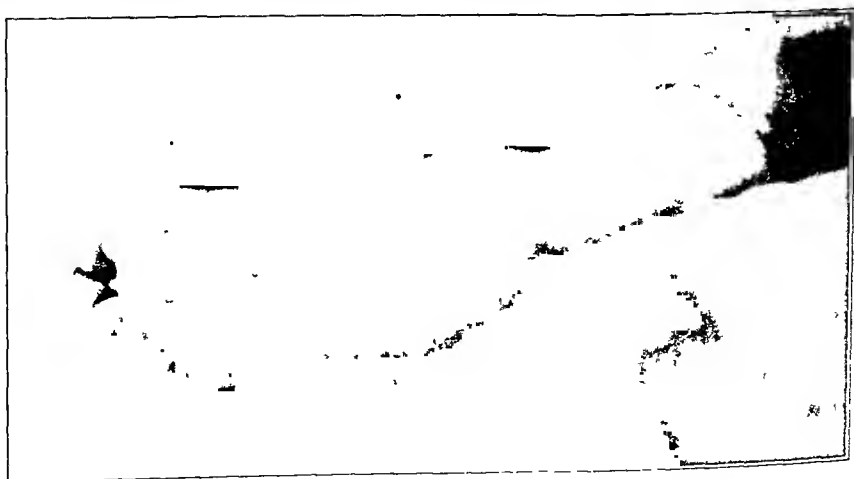


FIG. 1

Showing the thickening of the plantar fascia of the right foot.

followed the fractures. The appearance of the right foot and the hands is shown in Figures 1 and 2. On January 6, 1938, an attempt was made to excise the entire thickened palmar fascia of the left hand as well as the bands causing contracture of the fingers and thumb, and to interpose a layer of fascia lata between the denuded flexor tendons and the skin. However, the nutrition of the latter was poor and necrosis followed, with subsequent scarring. It is now proposed to amputate the useless little finger and to utilize some of its healthy skin to epithelize the palmar surface.

On October 20, 1938, the thickened, hardened plantar fascia of the right foot was excised. This was extremely dense and firmly adherent to the skin and to the muscular



FIG. 2

Bilateral Dupuytren's contracture.

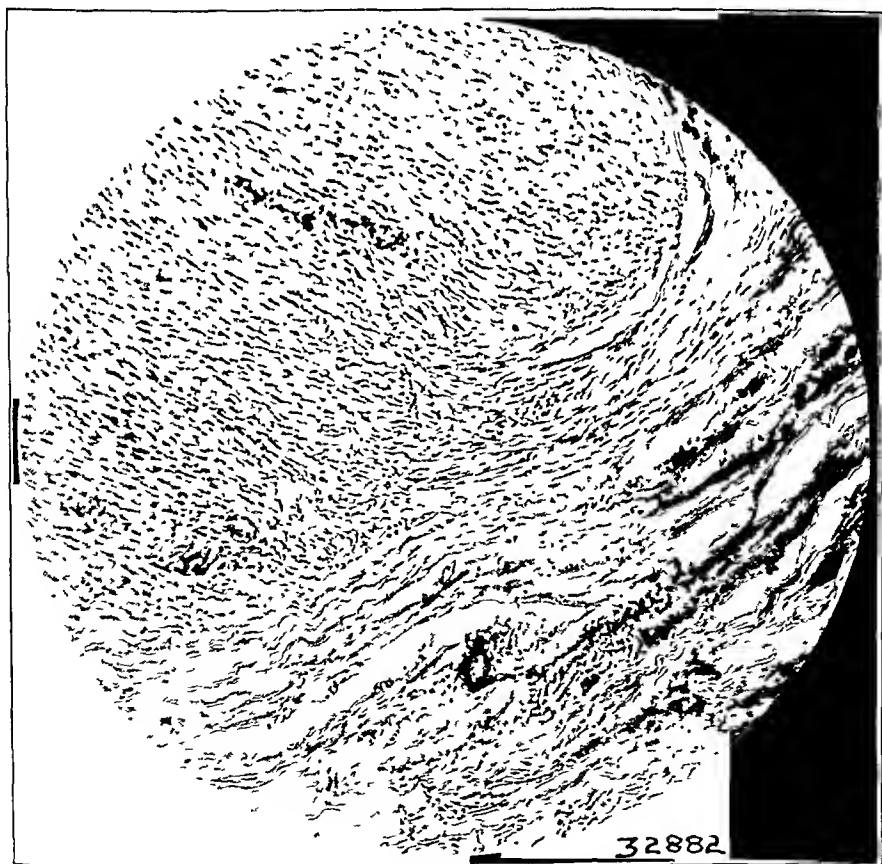


FIG. 3

Photomicrograph of a section of the specimen removed from the right foot.



portion of the flexor brevis digitorum. Sharp dissection was from these structures; the adherent skin was removed with the excised measured six and five-tenths by two and five-tenths by wound healed *per primam*, and recovery was uneventful. Figure histological picture first described by Janssen: spotty ("fleckweis" connective tissue and enormous hypertrophy of adventitia of large vessels, no arteriosclerosis. The process was distinctly not inflammatory, trophic. In some areas the cells were few and the tissues shrunken, sure necrosis.

#### SUMMARY

This is the report of a case of bilateral Dupuytren's typical in appearance and distribution, in which there was at the same time an involvement of the plantar fascia of the right foot. The removal of the mass from the foot was followed by relief. Section of the excised tissue showed the typical histological appearance of Dupuytren's contracture.

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# BILATERAL OSTEOCHONDRITIS OF THE PISIFORM

## REPORT OF A CASE

BY ADOLPH A. SCHMIER, M.D., NEW YORK, N. Y. AND MAURICE P. MEYERS,  
M.D., DETROIT, MICHIGAN

*From the North End Clinic, Detroit, Michigan*

Osteochondritis is a well-established entity indicating ordinarily a non-inflammatory disturbance in the normal bone growth occurring within the center of ossification. Although the exact etiology has not been definitely determined, many theories have been advanced. Among them are Axhausen's theory of infarcts, the endocrine theory, the nutritional theory, hereditary influence, congenital anomaly, infection, and trauma. The process has been described in various centers of ossification in the body and usually occurs at the time of their greatest developmental activity.

The case here reported is one of bilateral osteochondritis of the pisiform. The history and roentgenographic findings correspond to those ordinarily associated with osteochondritis in other sites. In reviewing the literature, we have been unable to find a single report of involvement of this bone.

### CASE REPORT

A boy, twelve years old, had fallen five years before he was seen by the authors, sustaining a laceration on the hypothenar eminence of the left hand. The wound had healed, but the patient had subsequently experienced pain on the ulnar side of the hand. Later a small mass appeared on the lateral aspect of the eminence, distal to the site of the pisiform. Roentgenographic examination revealed the presence of a foreign body. In addition, changes were noted in the pisiform. In the anteroposterior view, taken on October 23, 1936, the bone was indistinct in outline and presented a dense mottled appearance. The lateral view (Fig. 1) more clearly indicated the fragmented appearance of the bone. The outline of the bone was irregular and areas of rarefaction and condensation were present, producing a mottled, moth-eaten appearance. An anteroposterior view of the right hand, taken for comparison on October 28, 1936, disclosed a similar change in the pisiform. Clinically, there was no tenderness over either pisiform, and



FIG. 1

Lateral view of left wrist on October 23, 1936. The pisiform is fragmented, and its outline is irregular. Areas of rarefaction and condensation produce a mottled appearance.

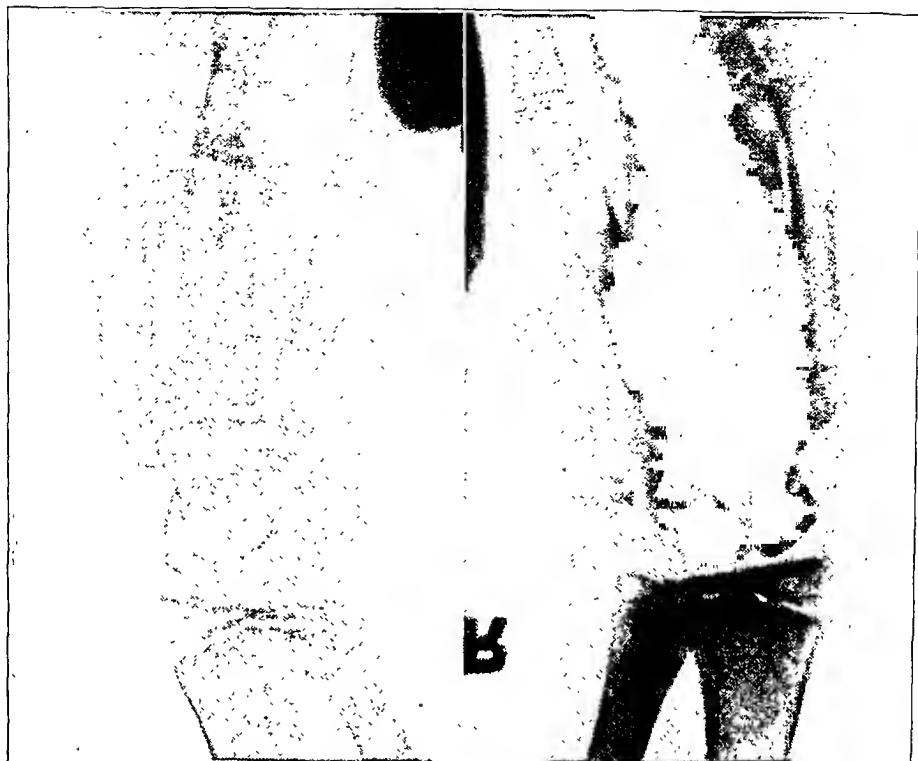


FIG. 2

Oblique view of both wrists on November 16, 1936. The left pisiform is more homogeneous, and there is less fragmentation. The hazy, mottled appearance is still present to some degree in both bones.



FIG. 3

Oblique view of both wrists on January 29, 1937. The outline of both bones is more distinct. No clear-cut fragmentation is seen in left pisiform. The right pisiform still shows some irregular condensation. Healing is evident in both.



FIG. 4

Oblique view of both wrists on January 26, 1939. Both bones are homogeneous and their outlines are regular. Slight vacuolation is still noted, especially in the right pisiform.

the patient had no pain referable to these regions. Upon further inquiry, the boy related a vague history of recent trauma, stating that several weeks before he had run into another boy, with the hands outstretched.

Because of the absence of symptoms referable to the pisiforms, no therapy was instituted. The foreign body in the left hand was removed. Since osteochondritis is considered a self-limiting disease, terminating at the end of ossification, further roentgenograms were taken to observe the progress of the affection. Oblique views of both hands (Fig. 2), taken on November 16, 1936, still showed the hazy, mottled appearance of both pisiforms. The left pisiform exhibited less fragmentation when compared with the original roentgenogram. Areas of rarefaction and condensation were still present, but the bone had a more homogeneous appearance. The findings in the right pisiform were similar, but more marked. Roentgenograms (Fig. 3), taken on January 29, 1937, showed some swelling and mottling in both bones. However, the outline of the bones was more distinct and regular than previously noted. The left pisiform was more homogeneous, and no clear-cut fragmentation was seen. Healing was definitely taking place in both bones, although more slowly in the right. According to most authorities, ossification of the pisiform in males is complete at the end of the fifteenth year. From the comparative roentgenographic studies, it was felt that the process would probably terminate before that time in this case.

The patient was lost sight of until recently, when he was again seen on January 26, 1939, at which time he stated that he had had no pain or disability in either wrist. Oblique roentgenograms (Fig. 4) revealed complete ossification and normal appearance of both pisiforms.

In the case of bilateral osteochondritis of the pisiform reported, the roentgenographic features correspond to those usually associated with osteochondritis elsewhere. Its occurrence in the pisiform is apparently rare, since no similar case could be found in the literature.

# CONGENITAL BILATERAL TALIPES EQUINUS IN TWINS

BY PAUL W. LAPIDUS, M.D., F.A.C.S., NEW YORK, N. Y.

*From the Hospital for Joint Diseases\**

Identical congenital malformations are known to occur sometimes in twins. The author wishes to report the cases of twins who had bilateral congenitally short Achilles tendons.

Twin girls, fifteen and one-half years old, consulted the writer at the Clinic of the Hospital for Joint Diseases on November 20, 1937, because of their inability to place the heels on the ground. Since the girls first started to walk it had been noted that they were able to bear weight only on the tips of their toes. The parents had never sought professional advice, since the girls experienced practically no discomfort pertaining to their feet and legs. They were able to walk long distances, to run and play games at school, and to participate in all normal activities. However, they felt slightly more



FIG. 1-A

FIG. 1-B

Before operation, June 28, 1938.

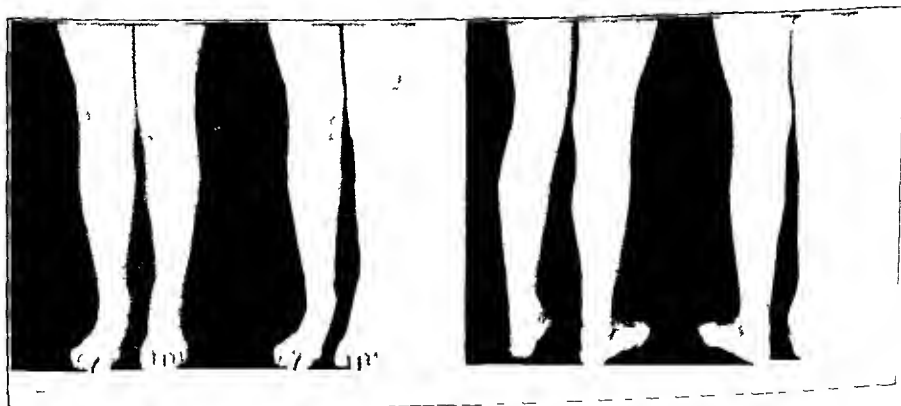


FIG. 2-A

FIG. 2-B

After operation, November 12, 1938.

\* Service of Leo Mayer, M.D.

comfortable when they started to wear high heels. When engaging in gymnastics and wearing rubber sneakers, they walked on their toes. This, however, in no way hampered them. At no time did they complain of any pain or tenderness in the lower limbs.

The twins were born of a tenth pregnancy. There was no deformity of the feet in any known relatives.

Upon examination, the girls were apparently well developed and perfectly well. Systemic examination and all the laboratory findings were negative. There was no limp noticeable when the patients walked with heels about four centimeters high. They were able to bring the heels to the ground only when standing with the thighs slightly abducted and markedly externally rotated, and with the knees in hyperextension. Both thighs and calves were well shaped and equal in circumference. The feet were of the long narrow type with slightly exaggerated longitudinal arches. Both feet were held in equinus of about 25 degrees and could not be passively dorsiflexed beyond this angle. With the knees flexed at about 90 degrees (when the gastrocnemius muscles were relaxed), about 10 degrees more of passive dorsiflexion of the feet could be obtained. On attempting forceful dorsiflexion of the feet with the knees extended, the patients felt slight pain or, rather, strain back of the knees. There was no spasticity whatsoever of any muscles of the lower extremities.

On June 27, 1938, both patients were admitted to the Hospital, and on June 29 an open Z-shaped lengthening of the Achilles tendons and a thorough posterior capsulotomy, especially over the medial and lateral aspects back of the ankle joint of each foot, were performed. The patients made uneventful postoperative recovery and were discharged from the Hospital on July 8, 1938.

When last seen on December 22, 1938, about six months after the operation, the patients were able to walk in a normal fashion with and without their shoes. There was perfect regeneration of the lengthened Achilles tendons with good power in the calf muscles, so that the patients were able to walk on the tips of the toes.

#### SUMMARY

In the cases of bilateral talipes equinus occurring in twin girls which have been reported, the deformity was corrected by means of open lengthening of the Achilles tendons and posterior capsulotomy, with good functional results.

# ARM CONTROL FOR OPERATIONS ON THE UPPER EXTREMITY ON THE HAWLEY TABLE

BY GEORGE W. HAWLEY, M.D., F.A.C.S., WESTPORT, CONNECTICUT

Surgeons frequently experience difficulty in securing satisfactory exposure, control, and fixation in operations on the arm and forearm. Fracture and orthopaedic tables have stressed traction and suspension of



FIG. 1

Arm board attached to table. Hook above elbow regulates traction, which may be little or considerable. Bandage traction to two posts. Pronation or supination by reversing ends of bandages.

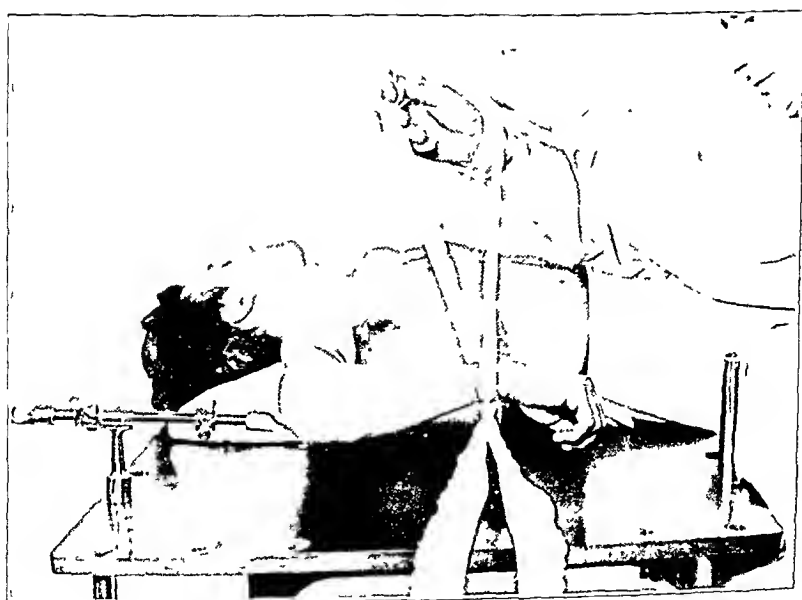


FIG. 2

Convenient and safe method of traction without constriction. Two pieces of muslin bandage are tied in a surgical knot on one side of the wrist and then a knot is tied on the opposite side, making a moderately loose loop. The ends of the bandage are tied to posts.

the lower extremity with the leg straight. The problem is altered when dealing with the upper extremity, because the position favored is with the elbow flexed, whether or not traction is used.

In redesigning his table a few years ago, the writer sought to make it as useful for the arm as for the leg. This is now thought to be one of the most satisfactory features and one which has not been fully appreciated or taken advantage of by those who are now using this table.

The accompanying illustrations with a subject undraped convey some idea of the surgical exposure, stability, availability of traction when desired, exposure for roentgenographic examination, and suspension for dressings or plaster when indicated.

The arm board (Fig. 1) is non-obstructive to the roentgen rays, so the tube beneath the table makes possible the rapid taking of roentgenograms or the use of the fluoroscope. A pillow can be placed under the suspended

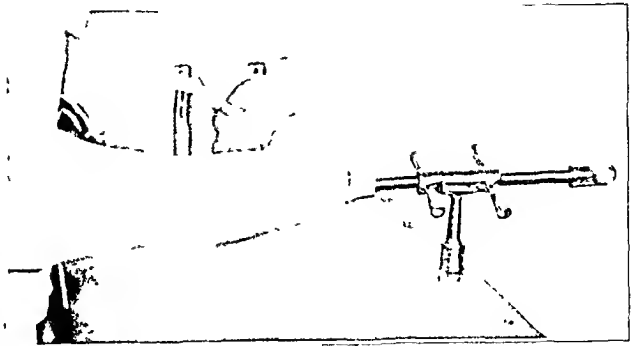


FIG. 3

Control and exposure of arm, using traction of body weight only. The forearm is out of the way and secured.

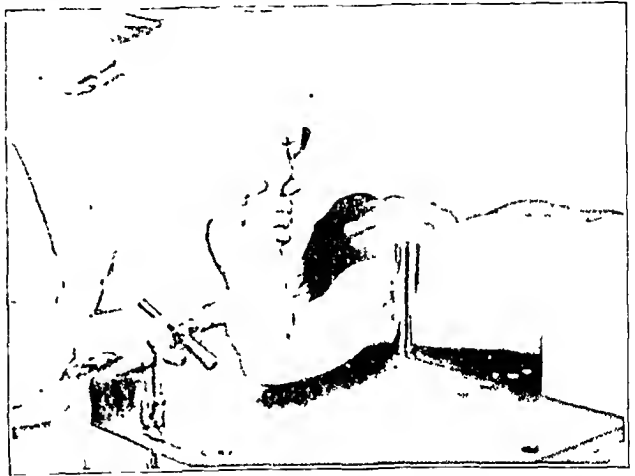


FIG. 4

Reduction of shoulder dislocation. The thorax is fixed by the axilla post. The elbow hook is used for slow, gradual traction under definite control.

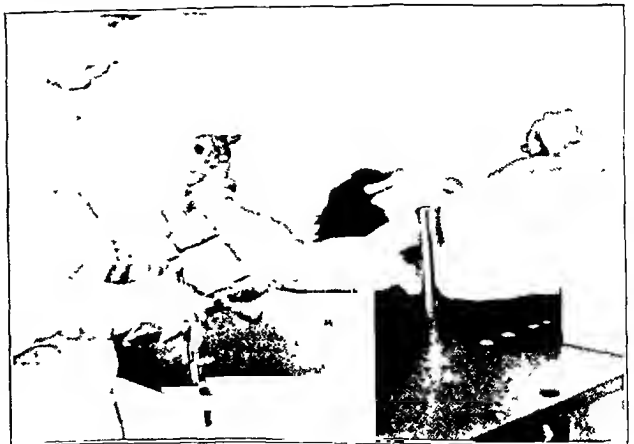


FIG. 5

Showing traction and external rotation.



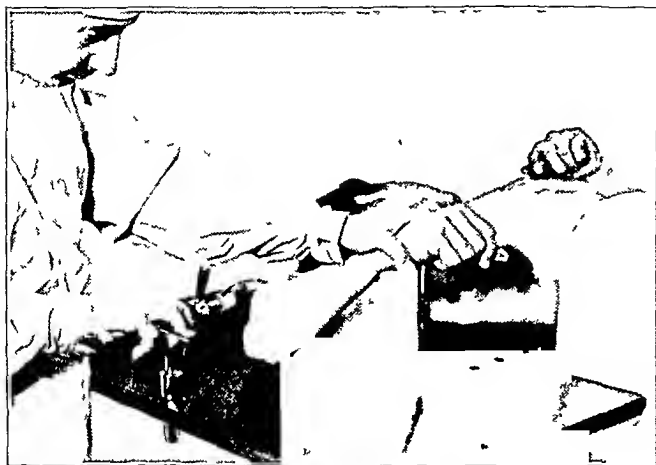


FIG. 6  
Showing traction and internal rotation.

forearm and removed after operation. Kirschner-wire traction through the lower end of the radius can be obtained if desired.

By means of the muslin bandage (Fig. 2), a surprising amount of traction can be obtained.

Figure 3 shows the control and exposure of the arm, using traction of body weight only. If strong

traction is desired, the axilla post (Fig. 4) can be used.

In reducing a shoulder dislocation (Fig. 4), roentgenograms can be taken before and during the progress of reduction. The main features of Kocher's method can be carried out,—namely, traction, external rotation, and internal rotation. The arm cannot be adducted, however, but the writer believes that this is unimportant, unnecessary, and sometimes harmful.

While the surgeon regulates traction and external rotation (Fig. 5), the assistant can exert hand pressure on the displaced head of the humerus. This has been found very successful without necessarily using anaesthesia. The slow, even, controlled traction and manipulation do not cause much of any discomfort or pain.

In the opinion of the writer, the method of traction and internal rotation shown in Figure 6 is superior to manual reduction. It is less fatiguing to the surgeon and permits him to proceed more deliberately. The muscles relax more readily under a slow, steady, even pull. Resistance and muscle spasm are noticeably less than with unsteady manual traction, and there is no need of using haste or a force which can do any harm.

## ELASTIC STRAPS TO PREVENT SLIPPING OF A KNEE CAGE

BY RAPHAEL R. GOLDENBERG, M.D., PATERSON, NEW JERSEY

*From the Hospital for Joint Diseases,\* New York City*

Orthopaedic surgeons have long felt the need of a knee brace which will not slip. In order to overcome this difficulty, a Thomas caliper brace has been substituted in cases where support to the knee alone is necessary. Many patients object to a caliper brace, because it is heavy, expensive, and unnecessarily conspicuous.

The arrangement of elastic straps to be described has been used repeatedly by the author and has been found eminently satisfactory.

The apparatus consists of the usual type of knee brace with retention elastic straps. The brace, briefly described, is made up of two uprights or bars of 17 S.T. aluminum†. Each bar extends for approximately six inches above and below the joint line. A hinge joint with a stop is attached to the outer bar and is placed at the middle of the joint line. The stop is made of 18-gauge monel with a set screw, which will check either flexion or extension as desired. A thigh band and a calf band are placed anteriorly three inches above and the same distance below the joint line. Each band is one inch wide, made of 17 S.T. aluminum, and covered with leather.



FIG. 1-A

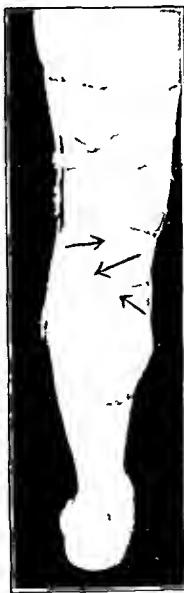


FIG. 1-B



FIG. 1-C

\* Orthopaedic Service of Samuel Kleinberg, M.D.

† An aluminum alloy, composed of 4 per cent. copper, .5 per cent. manganese, .5 per cent. magnesium, and 95 per cent. pure aluminum, and treated by heat.

At the back of the calf and the thigh are two straps of India-rubber silk elastic approximately one and one-half to two inches wide. The lower strap runs from the inferior part of the inner bar just below the popliteal space. It passes through a nickel-plated brass loop, across the calf through a second loop on the inner bar at the same level, and then courses downward and outward obliquely across the calf to the lower part of the outer bar, where it is fastened by means of an adjustable leather strap and button. The upper strap takes a similarly crossed course beginning from the inner bar just above the popliteal space and continuing to the upper part of the outer bar. The accompanying illustrations show the knee cage and straps in use.

## JOHN DANE

1866-1939

Dr. John Dane died at his home on Woodland Road, Jamaica Plain, Massachusetts, on March 27, 1939.

Dr. Dane graduated from Harvard College in 1888 and from Harvard Medical School in 1892, with *cum laude* degrees. After a surgical internship at the Massachusetts General Hospital, he also served as an intern at the Infants' Hospital and at the Children's Hospital, in which capacity he showed early in his career his interest in children and in the problems of their care.

After completing his preliminary training, he traveled extensively abroad, visiting hospitals and art centers. He studied in the principal hospitals abroad which were then distinguished for their work in orthopaedic surgery, and made many friends among well-known orthopaedic surgeons, which gave him a lasting contact with this group. His interest in art also became a prominent factor in his life.

He returned in 1895 to establish himself in Boston. He was connected with the Marcella Street Home for Children, the Infants' Hospital, and the Children's Hospital. To this latter institution he gave primarily of his time and efforts. He served there for a long period, in which he took an active part, and was recognized as a skillful and resourceful surgeon. He always maintained a deep interest in the care of children and gave of his best from a resourceful capacity to improve the methods for their comfort and relief.

For several years he was an instructor in the Medical School of Harvard University, a position for which he was particularly well fitted because of his clearness of thought and directness of action in dealing with problems combined with his knowledge and experience; and he could always stimulate and lead his students.

He early became interested in manipulative surgery, which is now attracting the attention of so many orthopaedic and traumatic surgeons. His mind was particularly alert and he threw himself wholeheartedly into all of his endeavors. He studied this branch of surgery with the same thoroughness and intelligent understanding which characterized all of his undertakings, and from his experience he gave all that he could to aid his fellow practitioners toward their understanding of the work.

Dr. Dane's life was enriched by many of the finer influences of life beyond the field of surgery. He traveled abroad extensively and was a connoisseur and collector of art; he lived in that atmosphere for a part of his time, and he always maintained his ideals. He gave liberally of his companionship, and he was a good friend and a loyal associate.

## PHILIP HOFFMANN

1870-1939

Dr. Philip Hoffmann died suddenly on April 21, 1939, in St. Louis, at the age of sixty-nine. He was one of the older members of the American Orthopaedic Association, in which he was elected to membership in 1898.

Dr. Hoffmann was born in St. Louis and had always been a resident of that city. He was graduated from the Missouri Medical College in 1892. After an internship in the Female Hospital, he began the practice of orthopaedic surgery. In 1893, he was appointed Instructor in Orthopaedic Surgery at the Missouri Medical College, and served in that capacity until 1900, when this institution became the Medical School of Washington University. At Washington University Dr. Hoffmann was a Lecturer in Orthopaedic Surgery until 1910. In 1921, Dr. Hoffmann became Professor of Orthopaedic Surgery in the St. Louis University School of Medicine, and in 1924, head of the newly established Department of Orthopaedic Surgery in that School. He served in this capacity until 1938, when he resigned as active head and became Professor Emeritus. His painstaking care, his thoroughness, and his remarkable power of observation, coupled with his ability of clear demonstration, made him an excellent teacher. He brought an enthusiasm and a sympathetic understanding to his work that was an inspiration to his pupils.

Dr. Hoffmann had numerous hospital connections. He was on the staffs of the Firmin Desloge Hospital, St. Mary's Hospital, the Jewish Hospital, and the Bethesda Hospital, and was on the consulting staff of St. Mary's Infirmary. To all of these he gave the same untiring faithfulness and energy that he gave to his school work.

Always very active and full of energy, after his retirement he was a frequent visitor to the hospitals and clinics. He never missed the weekly ward rounds, and he loved to take part in discussions of diagnosis and treatment. His clear penetrating insight and friendly counsel were of great value and were always welcomed by the rest of the staff. It was a pleasure to work with him, for he was always gentle and considerate, but withal he had a keen penetration and could detect the good from the bad. He was an excellent diagnostician. He was also much interested in the mechanical side of the specialty, as well as in research and in anatomy.

Dr. Hoffmann had many other interests in addition to orthopaedic surgery. He was a man of broad culture, a lover of music, a wide reader, and a student of medical history. He was active in the work for crippled children and was on the Executive Committee of the Missouri Society for Crippled Children. As a fitting climax to a life devoted to the crippled, and especially to the crippled child, he died as he was attending the annual meeting of the Missouri Society for Crippled Children. His death will be deeply felt by all who knew him.

## JOSEPH EDGAR STEWART

1890-1939

On March 5, 1939, Joseph Edgar Stewart died suddenly in St. Louis, Missouri. He was born in Webb City, Missouri, in 1890, and was graduated from the University of Missouri in 1910 and from the University of Pennsylvania School of Medicine in 1914. After his graduation from medical school, he served as an intern in the Barnes Hospital during 1915 and 1916, where he came under the influence of Dr. Fred Murphy, Dr. Barney Brooks, and Dr. Nathaniel Allison. Largely as a result of Dr. Allison's influence and teaching, he became interested in and devoted his efforts to the practice of orthopaedic surgery. In 1917 he went to France to serve with the Barnes Hospital Unit No. 21, where he remained until April 1919.

On his return to St. Louis, he resumed the practice of orthopaedic surgery and continued his teaching and clinical work at the Barnes Hospital, the St. Louis Children's Hospital, and the Washington University Clinics. In addition to the work at these institutions, he was Orthopaedic Surgeon-in-Chief of the Missouri Pacific Hospital and of St. Luke's Hospital; he was on the staff of the St. Louis City Hospital, the Deaconess Hospital, the Jewish Hospital, and the St. Louis County Hospital; and he was Consulting Orthopaedic Surgeon at the Shriners' Hospital for Crippled Children.

Dr. Stewart was elected to membership in the American Orthopaedic Association in 1926, and he maintained an active interest in its affairs throughout his career. In addition to membership in his city and state medical societies, he was a Fellow of the American College of Surgeons, of the American Academy of Orthopaedic Surgeons, and of the Clinical Orthopaedic Society.

During his earlier years he devoted a good deal of time and effort to experimental work on fundamental problems related to orthopaedic surgery, but the demands upon his time and energy prevented him from carrying on his work in the laboratory. Consequently, his contributions to medical literature were mostly of a clinical nature.

By frequently attending scientific meetings and by extensive reading, he was usually familiar with the latest additions to the science and practice of orthopaedic surgery. These he tempered with his innate common sense and used in his practice. He was widely known for the soundness of his clinical judgment and for the excellence of his operative technique.

Next to his family, he loved his friends and his outstanding characteristic was his ability to make and to keep friends. Those who had the privilege of working with him found him a friendly and stimulating rival. He could always be called upon in an emergency to look after patients in the clinic or wards or to lecture to students, with the assurance that the work would be done gladly and well. If generosity is a fault, it was undoubtedly his greatest fault. He was a good companion and friend, and we unite with his family in sorrowing that such a man was stricken at the very peak of his career.

# News Notes

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The Fifty-Third Annual Meeting of the American Orthopaedic Association was held at the Hotel Statler, Buffalo, New York, on June 5, 6, 7, and 8, 1939, under the Presidency of Dr. W. W. Plummer. The scientific program was as follows:

## TUESDAY, JUNE 6

### *Morning Session*

Internal Structure of the Vertebral Body of Man as Related to Health and Disease.

Dr. George Wagoner, Philadelphia, Pennsylvania.

Orthopaedic Treatment of Marie-Strümpell Arthritis.

Dr. Loring T. Swaim, Boston, Massachusetts.

Epiphysitis of the Spine.

Dr. John G. Kuhns, Boston, Massachusetts.

Dr. Louis Nathan, Boston, Massachusetts. (By invitation.)

Compression Fractures of the Vertebrae in Diabetes.

Dr. Mark H. Rogers, Boston, Massachusetts.

Dr. Howard F. Root, Boston, Massachusetts. (By invitation.)

Spondylolisthesis.

Dr. H. H. Hitchcock, Oakland, California. (By invitation.)

### *Executive Session—12:00 Noon*

### *Afternoon Session*

Symposium on Acute Hematogenous Osteomyelitis—Dr. D. E. Robertson, Toronto, Canada, *Chairman*:

Canada, *Chairman*:

Experimental Production and the Use of Bacteriophage.

Dr. W. J. MacNeal, New York, N. Y. (By invitation.)

The Bacteriology, the Toxins, and Chemotherapy.

Dr. Champ Lyons, Boston, Massachusetts. (By invitation.)

Human Morbid Anatomy.

Dr. I. H. Erb, Toronto, Canada. (By invitation.)

Clinical Symptoms and Diagnosis.

Dr. Edwin W. Ryerson, Chicago, Illinois.

The Early Operative Treatment.

Dr. J. Albert Key, St. Louis, Missouri.

The Delayed Operative Treatment.

Dr. John Wilson, Los Angeles, California.

Conclusions.

Dr. D. E. Robertson, Toronto, Canada.

## WEDNESDAY, JUNE 7

### *Morning Session*

Blind Nailing of the T Fracture of the Lower End of the Humerus Involving the Joint.

Dr. Oscar Lee Miller, Charlotte, North Carolina.

Spasmodic Torticollis.

Dr. J. T. Rugh, Philadelphia, Pennsylvania.

Ununited Fracture of the Neck of the Femur Treated by Combining the Smith-Petersen Nail and Bone Graft without Opening the Hip Joint.

Dr. W. E. Gallie, Toronto, Canada.

Dr. F. I. Lewis, Toronto, Canada. (By invitation.)

## President's Address.

Dr. W. W. Plummer, Buffalo, New York.

## A New Approach to the Wrist Joint.

Dr. M. N. Smith-Petersen, Boston, Massachusetts.

*Afternoon Session*

## End Results of Epiphyseal-Arrest Operations.

Dr. C. Howard Hatcher, Chicago, Illinois. (By invitation.)

## A Further Study of the Head and Neck of the Femur in the Growing Child.

Dr. W. E. Wolcott, Des Moines, Iowa.

## Temperature-Controlled Healing of Experimental Fractures.

Dr. Kellogg Speed, Chicago, Illinois.

Dr. Egbert H. Fell, Chicago, Illinois. (By invitation.)

## The Pathology and Treatment of Subdeltoid Bursitis.

Dr. J. E. Milgram, New York, N. Y.

## Bone Tumors.

Dr. Louis Kress, Buffalo, New York. (By invitation.)

## THURSDAY, JUNE 8

*Morning Session*Symposium on Fractures of the Shaft of the Femur—Dr. Philip D. Wilson, New York, N. Y., *Chairman*:

## Emergency Treatment and Transportation Splinting.

Dr. Frank D. Dickson, Kansas City, Missouri.

## Treatment of Fractures in Children.

Dr. A. B. LeMesurier, Toronto, Canada.

## Follow-Up Studies of Bone Growth in Cases of Fracture in Childhood.

Dr. Alexander P. Aitken, Boston, Massachusetts. (By invitation.)

## Treatment by Skeletal Traction and Thomas Splint.

Dr. George W. Van Gorder, Boston, Massachusetts.

## Treatment by Russell's Traction Method.

Dr. John Dunlop, Pasadena, California.

## Treatment by Pin and Plaster Method.

Dr. John R. Moore, Philadelphia, Pennsylvania.

## Ambulatory Method of Treatment.

Dr. Allen F. Voshell, Baltimore, Maryland.

## Open Reduction and Internal Fixation.

Dr. William Darrach, New York, N. Y. (By invitation.)

## Treatment of Malunited Fractures by Manipulation and Traction.

Dr. LeRoy C. Abbott, San Francisco, California.

## Treatment of Compound Fractures.

Dr. H. Winnett Orr, Lincoln, Nebraska.

## Chemotherapy in the Prevention of Infection in Compound Fractures.

Dr. Robert W. Johnson, Jr., Baltimore, Maryland.

*Executive Session—12:00 Noon*

Monday morning, June 5, was devoted to clinical presentations by Dr. W. W. Plummer and his colleagues. On Tuesday evening, June 6, the members and guests were entertained by Dr. and Mrs. Plummer at the Saturn Club. The Annual Dinner of the Association was held on Wednesday evening, June 7.

At the Executive Sessions, the following officers were elected:

President-Elect: D. E. Robertson, M.D., Toronto, Canada.

Vice-President: Wallace H. Cole, M.D., St. Paul, Minnesota.

Secretary: Ralph K. Ghormley, M.D., Rochester, Minnesota.

Treasurer: Rexford L. Diveley, M.D., Kansas City, Missouri.



The following Members of Committees and Delegates were elected:

Member of Membership Committee: LeRoy C. Abbott, M.D., San Francisco, California.

Member of Program Committee: R. I. Harris, M.B., Toronto, Canada.

Representatives on the American Board of Orthopaedic Surgery:

M. S. Henderson, M.D., Rochester, Minnesota.

A. B. Gill, M.D., Philadelphia, Pennsylvania.

Delegate to the American College of Surgeons: James Archer O'Reilly, M.D., St. Louis, Missouri.

The President for the current year is Frank D. Dickson, M.D., Kansas City, Missouri.

Elected to active membership in the Association were the following:

David M. Bosworth, M.D., New York, N. Y.

Harold H. Hitchcock, M.D., Oakland, California.

Francis M. McKeever, M.D., Los Angeles, California.

Leo J. Miltner, M.D., Davenport, Iowa.

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The next examination of the **American Board of Orthopaedic Surgery** will be held in conjunction with the meeting of the American Academy of Orthopaedic Surgeons in Boston, Massachusetts, in January 1940. Applications for this examination must be filed with the Secretary, Dr. Fremont A. Chandler, 6 North Michigan Avenue, Chicago, Illinois, on or before November 1, 1939.

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We are glad to announce that Dr. Royal Whitman has been elected a member of the French Academy of Surgery and an honorary fellow of the Royal Society of Medicine and of the Royal College of Surgeons. It is a great satisfaction to know that these societies have recognized the important rôle that Dr. Whitman has played in Orthopaedic Surgery, and have bestowed these honors upon him.

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Dr. Samuel Kleinberg and Dr. M. T. Horwitz of the **Hospital for Joint Diseases** are conducting an investigation of the obstetrical difficulties encountered in patients who have had infantile paralysis. This study is being pursued under a grant from the National Foundation for Infantile Paralysis. Physicians who know of any such cases are asked to communicate with either Dr. Kleinberg or Dr. Horwitz in care of the Research Department, Hospital for Joint Diseases, 123rd Street and Madison Avenue, New York, N. Y.

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The Ninth Annual Convention of the **Biological Photographic Association** will be held from September 14 to 16, 1939, at the Mellon Institute for Industrial Research, Pittsburgh, Pennsylvania. The program will be of interest to scientific photographers, scientists who use photography as an aid in their work, teachers in the biological fields, technical experts, and serious amateurs. Further information about the Convention may be obtained from the Secretary of the Biological Photographic Association, University Office, Magee Hospital, Pittsburgh, Pennsylvania.

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The 1939 Meeting of the **Deutsche Gesellschaft für Unfallheilkunde** will take place on July 7 and 8 in Kiel under the presidency of Dr. A. W. Fischer. The following program will be presented:

"A Review of Industrial Injuries and Their Prevention"—Dr. Bohnenkamp, of Freiburg.

"After-Care of Injuries of the Limbs"—Dr. Beghardt, of Hohenlychen.

"Indications for Corrective Osteotomies"—Prof. Hohmann, of Frankfurt.

"Accidents and Alcohol"—Dr. Jungnickel, of Göttingen.

"Injection Injuries"—Dr. Koestlin, of Stuttgart.

"Indications for Nailing of the Neck of the Femur"—Dr. Küntscher, of Kiel.

The Spring Meeting of the Minnesota-Dakota Orthopedic Club took place in St. Paul, Minnesota, on May 5 and 6, 1939. The annual dinner and business meeting were held on Friday evening, May 5, at the Minnesota Club. Saturday morning, May 6, was devoted to a clinical session at the Gillette State Hospital for Crippled Children, which consisted of operative demonstrations and the presentation of cases by members of the Club who are on the Staff of the Hospital. The meeting closed at noon with a luncheon given by the Hospital. Dr. George A. Williamson, of St. Paul, is President of the organization and Dr. John F. Pohl, of Minneapolis, Secretary-Treasurer.

At a recent meeting of the Executive Committee of the British Orthopaedic Association, the following orthopaedic surgeons were elected to Associate Membership:

Mr. Robert Bewick, 55 Union Street, Burton-on-Trent.

Mr. Hugh Carson, 21 St. Mary's Road, Harborne, Birmingham.

Mr. F. S. Chaplin Pritchard, 143 Harley Street, London, W. 1.

Mr. F. C. Durhin, Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry.

Mr. F. C. Dwyer, Medical Institution, Mount Pleasant, Liverpool 3.

Mr. Newton Heath, 6 Parkdale Court, Parkdale, Wolverhampton.

Mr. A. M. O. H. MacGowan, 63 Edgemont Gardens, Langside, Glasgow, S. 1.

Mr. N. W. Nisbet, Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry.

Mr. K. I. Nissen, 9 Worsley Road, Hampstead, N.W. 3.

Mr. James Patrick, 88 Ashdell Road, Sheffield 10.

Mr. R. N. Traquair, Princess Margaret Rose Hospital, Fairmilehead, Edinburgh.

The Fourth Congress of the International Society of Orthopaedic Surgery and Traumatology will be held in Berlin, September 4 to 8, 1939, under the Presidency of Prof. Georg Hohmann of Frankfurt am Main.

Following the opening of the Congress by Prof. Hohmann, the President of the Society, Prof. Louis Ombrédanne, of Paris, will give an address and the General Secretary, Dr. Delehef, of Brussels, will present a report.

The first main subject to be considered by the Congress is "The Results of Open and Closed Treatment of Congenital Dislocation of the Hip". The following surgeons will give the results of their experience with these two types of treatment: Prof. Franz Sehide, Leipzig; Dr. A. Bruce Gill, Philadelphia; Dr. Leveuf, Paris; Dr. Seaglietti, Bologna; Prof. Zahradníček, Prague.

The second topic, "The Treatment of Fracture of the Neck of the Femur", will be discussed by the following surgeons: Prof. Lothar Kreuz, Berlin; Dr. Lagomarsino and Dr. Valls, Buenos Aires; Dr. Tavernier, Lyon; Dr. Gruea, Lwów; Dr. Sven Johansson, Göteborg.

Members of the Congress will also have the opportunity of attending the sessions of the Deutsche Orthopädische Gesellschaft, which will be held in Berlin on September 8 and 9. In addition to the scientific program, trips about Berlin and to nearby points of interest have been planned, and there will be a special performance given at the *Deutsche Opernhaus* in Charlottenburg.

The Thirty-Fourth Congress of the Deutsche Orthopädische Gesellschaft will take place in Berlin on September 8 and 9, 1939, under the Presidency of Dr. Hellmüt Eckhardt.

The papers to be presented have been grouped under two main heads. The first subject, "Pseudarthroses", will be discussed by Prof. Peter Pitzen, of Giessen; Dr. Friedrich Pauwels, of Aachen; Dr. Hermann Watermann, of Frauenburg; Dr. Peter Bade, of Hannover; Prof. Walter Müller, of Königsberg; Dr. Wilhelm Thomsen, of Frankfurt am Main; Prof. Max Lange, of Munich; Prof. M. zur Verth, of Hamburg; Prof. Otto Dittmar, of Heidelberg; Dr. Werner Block, of Berlin.

The second subject, "Epiphyseal Derangements", will be considered from three points of view:

1. "The Pathological, Anatomical, Clinical, and Roentgenographic Pictures. Differential Diagnosis." The speakers on this aspect will be: Dr. L. Roeren, of Süchteln; Dr. Greve, of Hannover; Dr. Johannes Elsner, of Dresden; Dr. Erwin Schrader, of Kassel; Prof. Karl Mau, of Hamburg; Dr. Leichs, of Munich.

2. "The Course of the Disease, Therapy, and Prognosis." Papers on this subject will be presented by: Prof. Otto Dittmar, of Heidelberg; Prof. Peter Pitzen, of Giessen; Prof. Walter Müller, of Königsberg; Prof. Hackenbroch, of Köln; Prof. Karl Bragard, of Munich; Prof. Franz Schede, of Leipzig; Dr. Alfred Hahn, of Hannover.

3. "Etiology and Statistics." This aspect will be considered by: Dr. Sell, of Giessen; Dr. Kurt Lindemann, of Hannover; Prof. Walter Müller, of Königsberg; Prof. L. Frosch, of Arnstadt; Dr. Marquardt, of Munich.

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The Eighth **Internationaler Kongress für Unfallmedizin und Berufskrankheiten** was held in Frankfurt from September 27 to 30, 1938.

In the joint session of the traumatic and industrial surgeons the subject of predisposition and wear and tear in their relation to accidents and injuries was discussed as follows: (1) from the pathological standpoint, by Dr. Siegmund, of Kiel; (2) from the point of view of internal medicine, by Dr. Ferranini, of Bari; (3) from the surgical standpoint, by Dr. Deberville, of Paris; (4) from the point of view of heredity, by Dr. v. Verschuer, of Frankfurt; (5) from the dermatologist's standpoint, by Dr. Friboes, of Berlin. The neurological aspect was to have been discussed by Dr. Crözon, of Paris, who died shortly before the opening of the Congress, so that his paper had to be read.

Due to the lack of time, the discussions by Dr. Schulze, of Berlin, and Dr. Schröder, of Kissingen, on the effect of amputation of a limb on the entire organism were somewhat brief.

In the section on Traumatic Surgery, of which Prof. Magnus of Munich was Chairman, the question of injuries of the peripheral nerves was considered by Dr. Foerster (Breslau), Dr. Stender (Breslau), Dr. Ehalt (Vienna), Dr. Troell (Stockholm), Dr. Diez and Dr. Aprasio (Rome), and others.

The second main subject, "Injuries of the Feet", was taken up in a systematic study by Dr. Marangoni (Padua), from the point of view of the sequelae by Prof. zur Verth (Hamburg), and with reference to the preexisting conditions by Dr. Dubois (Bern).

Of the remaining papers, mention should be made of the following: "The Significance of the Vitamins in Traumatic Surgery", by Dr. Forster (Solothurn); "Electrical Accidents", by Dr. Koeppen (Leipzig) and Dr. von Alvensleben (Magdeburg); "The Treatment of Severe Burns", by Dr. Lotichius (Munich); "The Treatment of Fractures of the Vertebrae", by Dr. Burkle de la Camp (Bochum); "Fractures of the Os Calcis", by Dr. Gollasch (Hamburg); and "Experiences in the Abyssinian and Spanish Wars", by Dr. Chiurco (Siena).

The next Congress will be held in Rome in 1942.

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The **American Society for the Study of Arthritis** held its Tenth Annual Meeting in New York, on May 11, 12, and 13, with headquarters at The Waldorf-Astoria.

Thursday morning, May 11, was devoted to an informal discussion of arthritic problems. In the afternoon the first paper presented was "The Progression of Deformities in Arthritis", by Dr. John P. Stump, an excellent and carefully prepared demonstration of progressive postural defects in uncorrected deformities of the arthritic. This was followed by Dr. Conrad Berens's paper on "Rheumatic Infections in Relation to the Eye", a scholarly summary of our present knowledge of the subject. Dr. B. E. Christensen then gave a "Preliminary Report on a New Type of Stock Vaccine", using a mutant sarcinal bacterin capable of dissociation into active streptococcal forms. Dr. C. C. Fuller presented his studies on "Cellular Exudate in Intestinal Infection", with particular reference to its diagnostic value in infective colitis. The last paper of the afternoon

was "A New Drug for Relief of Spasm and Pain", a discussion of the value of aciform II, presented by Dr. Laurence H. Mayers.

The open meeting on Thursday evening was called to order at the New York Academy of Medicine. In the introductory address of the Chairman, Dr. Reginald Burbank stressed the inadequacy of clinical treatment for the arthritic in the United States as contrasted with the facilities offered in Sweden. The first scientific paper was on the "Modes of Streptococcal Invasion" by Dr. L. G. Hadjopoulos. This clearly summarized the fallacy of some of our concepts of continuity of tissue infection. Dr. C. M. Gratz and Dr. L. H. Meeker presented "Pathological Studies of the Fascial Planes Applied to Arthritic Surgery" and clearly demonstrated the evidences of infection as a causative factor in fascial adhesions. The third and last paper of the evening was "The Relationship between Plasma Proteins and Blood Sedimentation Rates in Chronic Atrophic Arthritis", a most careful summation of the researches on this subject presented by Dr. Roland Davison, Medical Director at The Desert Sanatorium in Tucson.

On Friday, May 12, Dr. H. Archibald Nissen gave a "Follow-up Study of Three Rheumatic Patients" with an extraordinarily careful investigation of predisposing factors from infancy through to the present time. In the afternoon Dr. R. L. Jeffery offered a preliminary report on the value of "Complement Fixation for Food Sensitivity in Arthritis". This was followed by a paper on "Differential Diagnosis and Orthopaedic Treatment" by Dr. Bernard L. Wyatt, illustrated by a number of reels of remarkable moving pictures. Dr. R. Garfield Snyder gave a restrained and cautious paper on "Gold Treatment for Arthritis", indicating its value but also the great need for caution that its use entails. The last paper of the day covered "Operative Procedures in the Care of Arthritis", by Dr. M. Beckett Howorth, and was a concise summary of the customary surgical procedures, their indications, and their value.

On Friday evening the dinner of the Society for members and invited guests was held in the Jansen Suite. Saturday was devoted to the closed meeting of the Society for the transaction of business.

The session of the *Réunion d'Orthopédie et de Chirurgie de l'Appareil Moteur de Bordeaux*, held on January 26, 1939, was opened by the President, Dr. Papin. After reports by the Secretary, Dr. Guérin, and the Treasurer, Dr. Pouyanne, the following papers were presented:

*Extra-Articular Arthrodesis of the Hip in Chronic Arthritis*—Dr. Lasserre.

In this paper Dr. Lasserre described a mixed arthrodesis in which he freshens the superior part of the femoral head and neck and creates an iliac shelf, which he reinforces with a thick osteoperiosteal graft. After several months a solution of continuity is produced in the region about the trochanter. The patient's gait is supple and painless and he can sit comfortably. This stabilization, which limits articular play, but permits a useful range of movement, is really an arthrocreisis, and is recommended in a limited number of cases.

*Treatment of Minute Fractures of the Femoral Head with Dislocation*—Dr. Nard.

Two cases were reported by Dr. Nard. The first, a minute fracture of the femoral head at the acetabular rim and dislocation of the hip, could not be treated by open reduction because examination revealed a fracture line at the level of the neck. Therefore, an osteotomy after the manner of Mommensen was performed, with an excellent result. In the second case, a very small fracture of the head (two fragments) with dislocation, treatment consisted in excision of the fragments and open reduction. In this case, although the anatomical result was perfect, there has developed a pseudarthrosis of the neck with decapitation of what remained of the head and upward projection of the greater trochanter.

*Post-Traumatic Periostoses of the Tuberosities and Calcification of the Shoulder*—Dr. Lasserre and Dr. Dotezac.

Three cases of calcification and post-traumatic periostoses of the tuberosities were reported. Case 1 demonstrated the late result of drilling of the tuberosity for periostosis

with subjacent decalcification. Anatomical pathological examination showed slight bone changes. The result is fairly satisfactory. Case 2 was that of a periosteal tumor of the tuberosity following a fall on the shoulder, in which roentgenotherapy has caused regression although function has been improved. In Case 3, calcification of the spinous processes, the treatment consisted in curettage. Pain has disappeared, function gradually being restored, and the patient is considered as cured.

*Congenital, Permanent, and Complete Dislocation of the Patella*—Dr. Lasserre and Dr. Dotezac.

In this case, that of a child, nine years of age, in whom this deformity had been increasing and causing disturbance in gait, the authors transplanted the patellar ligament and performed a plastic operation on the inferior fascia of the vastus medialis, to which was left adherent a fibrous band. There remains a limitation of flexion of the knee, but the patient is certainly improved.

*Congenital Elevation of the Right Scapula*—Prof. Charles Rocher and Dr. Soubiran.

The patient in this case was a child, four and one-half years old, with a pronounced congenital elevation of the scapula, which had been noted by the family since the age of eight months. Roentgenographic examination revealed a piece of bone joining the superomedial angle to the base of the occiput. The operation, performed by Prof. Rocher, consisted in resection both of the medial two-thirds of the scapula and of the piece of bone joining the scapula to the cranial skeleton, and in subclavicular myotomy of the trapezius. The inferior angle of the scapula was not fixed to the surface of the thoracic wall. A Minerva plaster cast, extending as far as the waist, was applied.

The program for the session of March 23, 1939, consisted of the following papers:

*The Role of Gymnastics in the Treatment and the Prevention of Surgical Tuberculosis and Scoliosis*—Prof. Rollier.

The need for developing to the maximum the musculature of young patients afflicted with surgical tuberculosis has led Prof. Rollier to supplement heliotherapy and orthopaedic treatment with gymnastic exercises, from which, of course, the involved limbs are exempt. Particularly good results have been obtained with the Margaret Morris system of exercises. In association with heliotherapy and the orthopaedic technique recommended by Prof. Rollier, in which the "ventral position" plays an important rôle, this system of gymnastics, combined with ski exercises, has yielded interesting results in the treatment of scoliosis.

*Treatment of Spasmodic Equinovarus by Myoplasty of the Gastrocnemius and the Soleus*—Dr. Lasserre and Dr. Dotezac.

In this article the authors stressed the advantages of the Van Assen technique, which diminishes the centripetal irritation and lengthens the triceps surae by separating from the muscle fibers the aponeurosis of insertion. They reported the case of a child, five years of age, with left spasmodic hemiplegia and marked equinovarus, in which the Van Assen operation was performed. The patient now walks with the aid of an orthopaedic sole of duralumin with an extension along the medial malleolus.

*Eversion of the Tibial Collateral Ligament of the Knee. Total Syndesmoplasty by a Free Strip of Fascia Lata*—Dr. Lasserre.

Dr. Lasserre reported the case of a patient who had sustained a severe sprain of the right knee while playing football. Forty-eight hours after the accident, after having made two tunnels in the region of the normal insertions of the tibial collateral ligament, the author performed a total syndesmoplasty with a free strip of fascia lata. The tunnels were horizontal, and the fascia lata was really in the form of a rectangle, the tension of which was regulated by silk sutures. Experience in this case showed that it was necessary to seek lateral and anteroposterior stability immediately. Flexion is now normal. This technique has attained a double end and has alleviated the rupture of the anterior cruciate ligament, the reconstruction of which had appeared useless.

*Marked Atrophy of a Leg Following Coxalgia in Infancy. Disarticulation at the Knee and Subtrochanteric Osteotomy*—Prof. Charles Rocher and Dr. Souhbiran.

The patient in this case was a child, fifteen and one-half years of age, who had had coxalgia since the age of twenty-one months. Examination revealed ankylosis of the thigh on the pelvis in flexion to 45 degrees, impossibility of extending the leg on the thigh beyond 90 degrees, and shortening of the femur of eighteen centimeters. In view of the probable impossibility of straightening the knee because of the adaptive retraction, a disarticulation at the knee was performed, followed by a subtrochanteric osteotomy.

*Extra-Articular Arthrodesis by Tibial Grafts for Osteo-Articular Tuberculosis of the Knee*—Dr. H. L. Rocher and Dr. Guérin.

In this case, that of a man twenty-six years old with tuberculosis of the knee of four years' duration, an arthrodesis was performed under spinal anaesthesia with tibial grafts on each side. Roentgenographic examination, six months after operation, showed perfect fixation of the grafts and preservation of the interline without bony fusion. The joint was solid to weight-bearing. These authors consider that arthrodesis should be reserved for inactive lesions accompanied by fibrous ankylosis. It is contra-indicated in tuberculous arthritis.

*A Contribution to the Study of Arthrodesis of the Hip*—Dr. H. L. Rocher, Dr. Guérin, Dr. Pouyanne, and Prof. Charles Rocher.

The authors have performed twenty-nine arthrodeses for coxalgia (in twenty adults and nine children), four or chronic arthritis, one for paralytic movable hip, and one for pseudarthrosis of the neck of the femur. These operations were performed in all stages of the lesions, but more conservatism was used in the child than in the adult. The techniques employed were usually minimum arthrodeses. In the majority of cases the operative approach was by way of a large incision (Smith-Petersen, Rocher, or Sorrel; rarely, by the incision of Ombrédanne or Mathieu).

The authors stressed the necessity of using massive grafts placed as near the vertical position as possible, so that their direction might correspond to the lines of force of the body. An osteotomy to correct adduction is necessary.

From the point of view of coxalgia, twenty arthrodeses in the adult resulted in primary cure in fifteen cases and in ultimate cure after repeated interventions in two cases. In children, nine arthrodeses resulted in primary consolidation in two cases and in secondary consolidation in four. In regard to operative complications, osteolysis followed traction of the adductors; suppuration rarely occurred. In chronic arthritis, firm consolidation was, in general, more difficult to obtain, and it was necessary to plan for large surfaces of bony contact.

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## BRITISH ORTHOPAEDIC ASSOCIATION

The Spring Meeting of the British Orthopaedic Association was held at the Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, on May 5 and 6, 1939, under the Presidency of Mr. Naughton Dunn. A very large number of members and guests attended the meeting and the Association Dinner held at the Grosvenor Hotel, Chester. Among the distinguished guests were Dame Agnes Hunt, and Dr. Delchef who represented the Belgian Government and the Belgian Orthopaedic Association. The social program included visits to places of architectural interest in and around Chester, to Powis Castle, and to Chirk Castle.

The scientific sessions were held at the Hospital. They included the Presidential Address, reviews of end results of various orthopaedic conditions—tuberculous and non-tuberculous—and examinations and demonstrations of patients under treatment by members of the visiting staff of the Hospital, assisted by the resident medical officers. A most interesting feature was a conducted tour of the Derwen Cripple Training Centre, which adjoins and is associated with the Hospital.

*Some Aspects of Bone Surgery* by Mr. Naughton Dunn, Birmingham.

In his Presidential Address Mr. Dunn gave a survey of the measures adopted to secure bony union in ununited fractures and in diseased and damaged joints. As a substitute for bone grafting, he advocated the subcortical exposure of the bone ends and a thorough refreshing, producing multiple chips with intact periosteal attachments. His lecture was illustrated by many successful results.

During the meeting a series of short papers were read, of which the following are résumés:

*Thoughts on Postural Function of Muscles of the Lower Extremity* by Mr. D. McCrea Aitken, London.

In a philosophical talk Mr. Aitken gave a most interesting account of some of his ideas on the postural function of the muscles of the lower limb. He emphasized the importance of these muscles in health and in disease, not only of the lower extremity, but also of the body as a whole. He stressed in particular the necessity and the value of the movement of rotation in all activities.

*Fractures of the Head and Neck of the Radius* by Mr. R. C. Murray, Oswestry.

This was a survey of 459 fractures of the head and neck of the radius, treated at the Liverpool Royal Infirmary during the ten-year period from 1927 to 1937. The majority of the fractures appear to have been caused by indirect violence, and they fall into six types. Concerning treatment, the following conclusions were reached:

1. Conservative treatment gives the best results in the majority of cases.
2. Operative treatment should be reserved for fractures of the neck irreducible by manipulation, for the removal of a completely detached fragment displaced into the joint, for grossly comminuted fractures, and for certain depressed marginal fractures. As a rule, complete excision of the head is preferable to partial removal.

*Late Results of Tuberculous Infection of the Sacro-Iliac Joints* by Mr. G. T. Partridge, Chester.

*Late Results of Tuberculous Arthritis of the Shoulder Joint* by Mr. S. Thompson, Oswestry.

*Late Results of Tuberculous Arthritis of the Knee Joint* by Mr. R. C. Murray, Oswestry.

This symposium represented a follow-up of the patients treated in the Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, from 1920 until 1934 for tuberculosis of the sacro-iliac joint (forty-eight patients), of the shoulder joint (twenty-seven patients), and of the knee joint (322 patients). A considerable mass of useful and informative facts resulted from this survey.

About one third of the patients with *sacro-iliac disease* died within four and a half years after the onset of the disease. The remainder were alive and for the most part well. The results following sound conservative treatment appeared to be as good and as lasting as those in cases in which a final arthrodesing operation had been performed.

*Tuberculosis of the shoulder* appeared to be a disease with a favorable outlook, usually affecting young adults. There was a long history of vague pain, but usually treatment was not undertaken until an abscess appeared. The presence or absence of a sinus had an important bearing on the prognosis, whether the treatment was conservative or operative. Conservative treatment was advisable until the disease was healed, when an extra-articular arthrodesis was a valuable stabilizing procedure.

*Tuberculous arthritis of the knee* occurred in about 11 per cent. of all cases of bone and joint tuberculosis treated in the Hospital. Primary *synovial* disease progressed to bone involvement in about 45 per cent. of the cases, requiring on an average about three years to do so. The *focal articular* type had a high mortality (22 per cent.), due to subsequent lesions elsewhere. In the majority of *extra-articular lesions* the prognosis was excellent. It was interesting to note that in tuberculous disease of the knee lengthening of the affected limb was twice as common as shortening.

*A Combined Bed Frame and Splint for Fractures of the Lower Limb* by Prof. E. W. Hey Groves, Bristol.

This ingenious apparatus consists of a portable tubular frame resembling a Bradford frame. To it is attached an adjustable back rest, and the mattress on it is partitioned to facilitate nursing. The object of the frame is to allow traction to be applied to both lower extremities with the patient in the sitting position. The traction need not be disturbed for transport, for the taking of roentgenograms, or for such operative procedures as the introduction of a Smith-Petersen nail into a fractured neck of a femur.

*The Treatment of Colles's Fracture* by Mr. J. H. Mayer, London.

In this paper the recurrence of displacement following apparently successful reduction and adequate splintage of Colles's fracture was commented on and the incidence placed as high as 50 per cent. Mr. Mayer attributed this redisplacement to the frequent occurrence of a supination of the lower radial fragment, which was often not corrected during attempts at reduction. Forceful pronation of the distal fragment was an essential step in manipulative reduction, and should be maintained by including the *wrist and elbow* in plaster-of-Paris. Sixty-three fractures were reviewed, and some interesting experimental work was also presented.

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## FREDERICK HOWARD MARSH

1839-1915

An old-fashioned clinician with scant sympathy for the revolutionary changes which shook the world of surgery around him, least of all for the germ theory of disease, Howard Marsh is gratefully remembered in the centennial year of his birth as one whose judicious conservatism restored health to countless tuberculous patients. The value of early diagnosis and of early and prolonged rest by fixation of diseased joints had already been stressed by Sir Benjamin Brodie, who was in the habit of applying extension somewhat clumsily and with an anatomical rather than a physiological bias. Howard Marsh's professional life was consecrated to the task of improving the conservative treatment of tuberculous joints, at a time when their early excision, especially in children, was fashionable. Extending the principles laid down in Hilton's *Rest and Pain*, he preached and practised treatment by continuous rest on splints, preferably by the sea. He was privileged to witness the successful, and today almost universal, adoption of his teaching, with sceptics and scoffers grudgingly, but surely, going to the wall.

When Marsh entered Saint Bartholomew's Hospital as a student in 1858, orthopaedic surgery was just beginning to establish itself in London as a separate branch of medicine. Put in charge of the Orthopaedic Department in 1878, he was appointed full surgeon to the Hospital in 1891, having served as assistant surgeon for the record number of seven-teen years.

As surgeon to the House of Relief for Children with Chronic Disorders of the Joints, later known as the Alexandra Hospital for Children with Hip Disease, he had an opportunity of showing that children with tuberculosis of the hip joint should not be permitted to run about as long as they were able, advocating early fixation by splints. Of these, he devised a number of ingenious models, a knee splint with side irons being particularly associated with his name.

As a teacher of clinical surgery in the out-patient room he was unconventional, homely, lucid, breezy, and full of sly humor. His writings, by way of contrast, were concise, polished, and elegant, and he was a persuasive and popular speaker. Perhaps his most valuable contribution to the literature is his work on "Diseases of the Joints", published in London and Philadelphia in 1886 and in Leipzig two years later.

Transferred from London to the chair of surgery at Cambridge in 1903, he ended his days as Master of Downing College, a genial, cheery, very human, and somewhat impulsive man, with a surplus of energy, and the possessor of strong views, to which he did not hesitate to give full expression.



# Current Literature

LEHRBUCH DER RÖNTGENDIAGNOSTIK (Textbook of Roentgenographic Diagnosis).

H. R. Schinz, W. Baensch, und E. Friedl. Beiträge von H. Franke, M. Holzmann, A. Hotz, E. Lindgren, E. Lysholm, E. Uehlinger, K. Ulrich, G. A. Weltz, und A. Zuppinger. 4. Aufl., II. Bände. Leipzig, Georg Thieme, 1939. 270 marks.

Although written by specialists, this textbook on roentgenographic diagnosis is not intended primarily for specialists in this branch of medicine. As the authors have stated in the preface, the main purpose of the book is to make available to every physician and student of medicine, as clearly and comprehensively as possible, the rudiments of roentgenographic technique and interpretation. Proceeding on the principle that actual example is a better teacher than mere description, the authors have included in this study of over 2000 pages 3658 carefully selected and beautifully reproduced roentgenograms, photographs, and diagrams, a few of which are in color. Each of the two volumes is divided into two parts, which greatly facilitates their use.

Volume I, entitled "The Skeleton", is of especial interest to the orthopaedic surgeon. The first part is devoted to the theory and technique of examination of the body by the roentgen ray, including a full discussion of the mechanism and the physical properties of the roentgen ray, thus affording the student a comprehensive grasp of this force and its action, as well as the knowledge of how to employ this energy. This portion should be studied carefully by those occupying themselves with this branch of diagnosis and therapy. The normal roentgenographic appearance of the skeleton is next discussed, followed by a detailed description of the pathological bone changes. A large portion of the volume is given to a review of the inflammatory diseases, and the remainder of the volume embraces the following subjects: primary bone cysts and tumors; metastatic bone tumors; deficiency diseases; hormonal diseases; disturbances in growth; hereditary diseases with bone changes; necrosis of the epiphyses and bones and derangements of the apophyses; differential diagnosis of bone diseases; deformities of the extremities; injuries and diseases of the joints; roentgenographic diagnosis of affections of the spine and the skull; muscles, tendons, connective tissues, blood vessels, thoracic and salivary glands; foreign bodies and their localization; the larynx and the hypopharynx.

Volume II, although of special interest to the medical internist, is also of value to the surgeon dealing with those affections in which the fields of the internist and of the surgeon are associated both in diagnosis and in treatment. This volume is devoted to a consideration of the internal organs, their processes, and their pathology, in which the roentgen ray is of diagnostic importance and of therapeutic value. The method of dealing with the gastro-intestinal tract and the conditions disclosed by the roentgen ray, with the significance of their appearance in diagnosis, have been given ample attention.

This book records the experiences of a group of men who have long worked in this special department of roentgenology, and they have brought the recognized knowledge up to date. The wide experience, careful study, and accurate interpretation on the part of the authors is evident throughout, and this work is a valuable contribution to the present knowledge of roentgenographic diagnosis.

SURGICAL ANATOMY. C. Latimer Callander, A.B., M.D., F.A.C.S. With a Foreword by Dean Lewis, M.D. Ed. 2. Philadelphia and London, W. B. Saunders Co., 1939. \$10.00.

Ever since its first appearance in 1933, Callander's textbook has held an established position of value in the teaching of Applied Anatomy. This second edition, entirely revised and reset, is unusual in that it has been reduced in size approximately one-third by the deletion of obsolete or unessential text and out-of-date illustrations. At the same

time, there have been added details of the more recent advances in the surgical anatomy of many topographic regions, especially in relation to lumbar sympathetic ganglionectomy, resection of the sacral plexus, scalenus anterior and cervical rib syndromes, spondylolisthesis, and surgery of the intervertebral discs and of the ligamenta flava. Many of the illustrations have been spaced more economically, and 100 new figures have been added, many of them being large pen-and-ink sketches showing steps of the standardized commoner surgical operative procedures. The total number of illustrations is now 819.

Dean Lewis, in his Foreword, calls attention to what Cheever has aptly and recently termed the "eclipse of anatomy". The clinical importance of gross anatomy, however, in its direct application to practical medicine and surgery remains unchanged. It is in this practical application to clinical problems that gross anatomy now finds its real field. Such a work as Callander's, highly admirable and satisfactory in every detail, is not only extremely valuable to teachers, students, and practitioners, but contributes materially to dispelling the eclipse of gross anatomy and restoring it to its true light as an ancillary science.

**DIE WINTERSPORTVERLETZUNGEN (Winter-Sport Injuries).** Dr. Marco Petitpierre. Stuttgart, Ferdinand Enke, 1939. 18.60 marks.

In a monograph of 205 pages, the writer has collected examples of the characteristic injuries which have been sustained at St. Moritz as the result of skiing, skating, and coasting. One hundred and ninety-seven excellent illustrations, many of which are partly in color, serve to clarify the mechanism, the anatomy, and the ideal methods of treatment. A statistical study of the cases over an eight-year period increases the importance of a book which should prove a valuable reference work for the orthopaedic surgeon, who will find in it numerous new and improved methods. It should be a boon to the general surgeon who is located at one of the newly developed winter-sport resorts.

**LÉSIONS ET TRAUMATISMES SPORTIFS (Sport Injuries).** Maurice Boigey. Paris, Masson et C<sup>ie</sup>, 1938. 65 francs.

This book of 325 pages is designed to serve the needs of the general physician, the professor of physical education, the trainer, those called upon to give first-aid treatment, or those engaged in sport. The work is divided into two portions. The first and shorter part is devoted to a general discussion of contusions, wounds, sprains, dislocations, fractures, shock, and exhaustion. The chapter on exhaustion resulting from overtraining and physical overwork is particularly well written and delineates the effects of overwork (acute or chronic) in the young, the adolescent, the adult, and the aged.

The larger part of the book is devoted to a hasty review of the injuries most common to boxing, running, jumping, football, wrestling, tennis, swimming, winter sports, equitation, or motor accidents. The lesions described include injuries not only to the skeletal system, but to all the anatomical parts of the body. In the discussion of the lesions of the skeletal system, the usual injuries are described and those which may be considered peculiar to a particular sport are especially stressed. In general, the descriptions are brief and clear. Mechanism is barely mentioned. Therapy is indicated only in broad outline. While this may be of value to "professors of physical education, trainers", etc., its significance for the orthopaedic specialist, interested in the minutiae of the different conditions, may well be questioned.

**THE GENUINE WORKS OF HIPPOCRATES.** Translated from the Greek by Francis Adams, LL.D. Baltimore, The Williams & Wilkins Co., 1939. \$3.00.

The critical determination of the authentic Hippocratic canon has always been a matter of concern to scholars, as well as of interest to the medical profession. About a hundred years ago, The Sydenham Society of England commissioned Francis Adams, a

Scottish surgeon and classicist of distinction, to investigate the matter and to translate the works which he regarded as genuine: His book, a scholarly work with numerous and extensive footnotes, was first published in 1849, again in 1886, and in 1929. In the present edition, most of the notes have been deleted, and the seventeen treatises which Adams believed from his investigations to be surely authentic have been arranged in such order as to present a continuous and connected picture of medicine in the Golden Age of Greece. An introduction by Dr. Emerson Crosby Kelly reviews the historical background of Hippocrates and quotes Adams's conclusions upon the Hippocratic canon. There is appended a series of eight plates, illustrating ancient surgical instruments.

Of the translation, which compares most favorably with later versions, such as that in the Loeb Classical Library, much praise may deservedly be spoken. The Scottish surgeon's long and accurate periods have a stately dignity and sonority which sort well with the original, and perhaps present it more appropriately than the shorter, crisper sentences of more modern translators. The volume makes easily accessible to every physician of today the works of the Father of Medicine, which for twenty-four centuries have formed the foundation of all medical literature.

**RHEUMATISM.** H. Warren Crowe, D.M. (Oxon), B.Ch., M.R.C.S., L.R.C.P. London, John Bale Medical Publications Ltd., 1939. 12 shillings, 6 pence.

This book is primarily for general practitioners, and the first half is devoted to a discussion of the nomenclature and classification, which is simply expressed. The general diagnosis and the differential diagnosis are taken up. Dr. Crowe has his own ideas about the grouping of arthritis, which are possibly a little different from others, in that he believes that there is an infective origin back of hypertrophic or osteo-arthritis,—as he calls it, an acute infective arthritis. He describes in detail the differential sedimentation tests, which he has developed at the Charterhouse Rheumatism Clinic. The pathology and morbid anatomy are carefully discussed, and there is a very clear statement as to the various factors which have to be taken into consideration in the etiology of rheumatic diseases. Special emphasis is laid on the infective factor, which Dr. Crowe firmly believes in. As he conceives it, "rheumatism is initiated by a microbic invasion of a traumatized area". Considerable space is given to the types of organism found. He believes that the other essential factor is the reaction of the tissues to the microbes, which produces the disease.

The last half of the book is devoted to a very good consideration of the general methods of treatment employed at the Charterhouse Rheumatism Clinic, with especial emphasis on the eradication of infection by the use of vaccine. A detailed description of the method of approach to the patient is given, and particular stress is laid on the method of use of vaccines, hypersensitivity, and focal infection. There is a good chapter on physiotherapy and manipulative procedures and an excellent chapter on the "wide-field" roentgen-ray therapy, which should interest those who have been using roentgen-ray treatment in rheumatic diseases. The other considerations of orthopaedic care are good. The concluding portion is devoted to bacteriological laboratory technique and to the technique of physiotherapy.

One may not agree entirely with Dr. Crowe's conception of the etiology or of the rôle which vaccines may play in the treatment of arthritis, but the book will interest all those who have been studying this type of disease.

**DER KREUZSCHMERZ IN SEINER BEZIEHUNG ZUR WIRBELSÄULE** (Low-Back Pain in Its Relationship to the Vertebrae). Priv.-Doz. Dr. J. E. W. Brocher. (Fortschritte auf dem Gebiete der Röntgenstrahlen, *Ergänzungsband LV.*) Leipzig, Georg Thieme, 1938. 21.50 marks.

At this time when so much is being written about slipped discs and the nucleus pulposus, it is interesting to read a monograph in which the author returns to the old

conception of referred pain as the explanation of many backaches. Good roentgenograms demonstrate the various bone abnormalities of the lumbosacral region, and other factors are discussed. Low-back pain is likened to the referred pain of angina pectoris with the stimuli transmitted over the sympathetic nerves from the lumbosacral facets. Symptoms appear when these joints are subjected to strain as the result of deficient musculature or unfavorable form or position of the vertebrae. It is unfortunate that this ninety-page monograph should be printed in the awkward folio size and that convention and perhaps economy placed the illustrations together at the back.

ST. THOMAS'S HOSPITAL REPORTS. Second Series, Volume III. Edited by Prof. O.L.V.S. De Wesselow and Mr. C. Max Page, assisted by Mr. N. R. Barrett, Dr. J. St. C. Elkington, and Dr. A. J. Wrigley. London, St. Thomas's Hospital, 1938. 10 shillings.

Only two of the articles in this series have been reviewed, as they are the only ones of particular interest to orthopaedic surgeons.

The report on "Ununited Fractures" by Mr. George Perkins will be read with interest by American surgeons, because it sets forth a number of ideas which are at variance with the generally accepted opinions in the United States. He labels as fallacious the theory that the interposition of soft tissue between bone ends is a possible cause of delayed union or non-union, and stresses the importance of end-to-end contact under pressure from Nature's muscular apposition. Mr. Perkins also takes exception to the idea that splinting has anything to do with immobilization in the treatment of fractures. He claims that it is only of service in maintaining alignment and that the surgeon does nothing and can do nothing to unite a fracture,—Nature, herself, attends to that. He contends that "ensheathing callus" will not be produced in sufficient abundance if the exudate around the site of the fracture is allowed to be drained off, and that synovial fluid, if it contacts fractured bone ends, will prevent union.

The article by J. D. Fergusson and F. C. Durbin, entitled "A Statistical Survey of the Results of Treatment of Fracture of the Patella", is a review of 146 fractures of this bone, treated on the House Service of St. Thomas's Hospital between 1924 and 1936, inclusive. Of these, 106 have been observed for the end results. These authors refer at the outset to Brooke's observation that the patella is either vestigial or absent in the faster moving quadrupeds and is, therefore, "phylogenetically inherited and its presence is not determined by function"; this is leading up to the modern treatment of fractures of the patella now having quite a vogue in England,—namely, its removal.

The cases are classified on the basis of the type of fracture (stellate or comminuted, or transverse) and whether they are due to direct or indirect violence.

The results of treatment of the different types of fracture are given in tabular form. No mention is made of any way of employing the suture material used except by the encircling method, and no other material except wire is recorded either in the tables or in the roentgenograms. This may account for the apparent willingness to accept as a "good" result separations up to one inch. It is claimed that these patients had satisfactory function, although 38 per cent. of them had limited motion, and only one out of eleven transverse fractures showed bony union. It is scarcely conceivable that a puckering-string suture, no matter how well closed the aponeurotic tear might be, could hold a transverse fracture in close enough apposition to secure bony union.

DER MENISCUSSCHADE. SEINE ÄTIOLOGIE UND SEINE BEGUTACHTUNG IM RAHMEN DER ALLGEMEINEN UNFALLBEGUTACHTUNG. (Injuries to the Meniscus. Their Etiology and Relation to Common Accidents.) Prof. Dr. Hans Burckhardt. (Beihefte zur Monatsschrift für Unfallheilkunde und Versicherungsmedizin, Heft 26.) Berlin, Julius Springer, 1939. 3.50 marks.

This is a monograph of forty pages, without illustrations, in which the author gives a very detailed description of the entire problem of injuries to the meniscus. Although

the author has not presented the results of new clinical, histological, chemical, or physical investigations, he has clarified the entire subject. It is an interesting monograph for those who can read German, and it is particularly timely at present when so much consideration is being given to the derangements of the knee joint (especially those which involve the meniscus), when fine distinctions are being made in diagnosis, and when more attention is being paid to the different forms of technique as well as after-care.

FROM HEAD TO FOOT. Armitage Whitman, M.D. New York, Farrar & Rinehart, Inc., 1939. \$2.50.

This small volume deals, in the earlier chapters, with a number of the more common orthopaedic subjects. By inheritance and personal experience Dr. Whitman is particularly well qualified to discuss these matters, and he has done so in an especially common-sense manner. In addition to his experience as an orthopaedic surgeon in private practice, as a member of the clinical staff of a metropolitan hospital clinic, and as a teacher of his specialty in one of our foremost medical schools, he has had opportunity to observe the working of an Industrial Accident Board in a state where the legislature has enacted a very comprehensive statute concerning the handling of the injured employee. His War service brought him into intimate touch with the disabled veteran. The last part of the book, which discusses "Social Service", "Workmen's Compensation", "Veterans", and "Operations", is a clear presentation of the situations which have to be covered for the employee, the employer, and the insurance company. He sets forth the issues in such a practical way that the glaring defects are apparent, and he makes sensible suggestions. Whether or not this book was intended for lay consumption, it is equally worth-while reading for the general practitioner or the specialist.

CRYSTALLINE ENZYMES. THE CHEMISTRY OF PEPSIN, TRYPSIN, AND BACTERIOPHAGE. John H. Northrop. New York, Columbia University Press, 1939. \$3.00.

This short monograph, based on the Jesup Lectures delivered at Columbia University, is an account of the work of Dr. Northrop and his colleagues in an important field of biochemistry. The successful isolation of pure crystalline enzymes has greatly simplified the investigation of enzymic reactions, and is likely to provide important new information about the chemistry of proteins. From both points of view, it is a very significant contribution to the study of the mechanism of vital processes. Dr. Northrop's monograph provides an excellent account of the methods used in the isolation of crystalline enzymes. Further details of these methods are given in an appendix. The introductory chapter briefly reviews the problems involved in the study of enzyme chemistry. The final chapter deals with the purification of bacteriophage, and concludes with an interesting comparison between the growth of bacteriophage and the production of active enzymes from inactive precursors. The book is illustrated by some beautiful photomicrographs of crystalline enzymes.

Dr. Northrop has played an outstanding part in the development of enzyme chemistry, and, for those working in this field, his book is invaluable as a summary of recent literature.

MUSKELMECHANISCHE PROBLEME BEI HÜFTGELENKSGABELUNG, PFANNENDACHPLASTIK UND ANDEREN EINGRIFFEN AN DEN UNTEREN GLIEDMASSEN (The Problems of Muscle Mechanics in Bifurcation of the Hip Joint, Shelf Operation, and Other Operative Interferences on the Lower Extremities). Dr. med. habil. Hermann Watermann. (Beilageheft zur Zeitschrift für Orthopädie, Bd. LXIX.) Stuttgart, Ferdinand Enke, 1939. 7.20 marks.

In this monograph of sixty-three pages, with many illustrations, the author analyzes the mechanical problems in various operative procedures. For the calcaneus deformity of the foot he proposes a method of correction and maintenance in a corrected position.

He describes a procedure by which the biceps femoris is so transplanted that it becomes an extensor, retaining its flexor function (becoming its own antagonist). There is a detailed analysis of principles involved in different forms of osteotomies below the hip joint, with a critical appraisal of methods proposed by others and a description of the author's method. The problem of the shelf operation is ably discussed. This monograph may be of sufficient interest to the American readers to justify a translation.

**FRACTURES AND DISLOCATIONS IN GENERAL PRACTICE.** (Lewis's General Practice Series.) John P. Hosford, M.S. Lond., F R.C.S. Eng. London, H. K. Lewis & Co., Ltd., 1939. 12 shillings, 6 pence.

This book is one of a series written by English authors as a text for general practitioners. Within the limits of the space allowed, the diagnosis and treatment of fractures according to modern accepted methods are clearly outlined. It is written very definitely for the general practitioner and carefully outlines methods which any practising physician may safely use. There are numerous bits of special information and words of advice concerning treatment scattered through the book which are obviously the result of the author's practical experience in the treatment of fractures. There are few illustrations, but the clarity of reproduction of the roentgenograms is excellent. The book can certainly be heartily recommended to those for whom it was primarily written,—that is, the general practitioners.

**CHRONIC ARTHRITIS IN WILD MAMMALS.** Herbert Fox. Philadelphia, The American Philosophical Society, 1939. \$2.00.

This monograph presents an intensely interesting study of chronic arthritis in wild mammals, based on analysis of 1749 skeletons and autopsies, representing all the principal mammalian orders. Out of this number, seventy-seven presented arthritic lesions strongly similar to the chronic deforming and rheumatoid arthritides in man. The highest incidence occurred among hyenas, of which nine out of fifteen had arthritis. Next in frequency were the anthropoid apes, baboons, tigers, bears, cattle, deer, and marsupials. It is noteworthy that no cases were found among many hundred dogs, wolves, foxes, jackals, rodents, small monkeys, bats, hedgehogs, sloths, and armadillos. It is surprising that no evidence was found of the etiological relation of diet, habitat, or focal infection to arthritis. The author regards body bulk, with its associated mechanical stresses of locomotion, as the most striking single feature among the arthritics. With the minor exception of the marsupials, the arthritics were all macrosomatous, whereas the non-arthritics were, on the whole, small beasts. Indeed, the rhinoceros and the camel were the only large animals examined that do not appear on the arthritic list.

**DER MUSKELRHEUMATISMUS.** Prof. Dr. Max Lange. Dresden, Theodor Steinkopff, 1939. 4.50 marks.

In this monograph of eighty-four pages, Prof. Lange reviews the two forms of muscular rheumatism seen in Germany. The first type, infectious muscular rheumatism, is usually the result of focal infection, and hard masses, similar to Aschoff bodies, are found in the muscles. The second form, non-infectious muscular rheumatism, is the commonest type, and it is seen particularly in cases where there is a rheumatic diathesis. These individuals are particularly susceptible to cold and dampness. Metabolic disturbances also play an important part in bringing on muscular rheumatism. Disturbances in internal secretion and allergic reactions are less important causes.

The differential diagnosis is usually not difficult, and is dependent upon the finding of hard masses or nodules in the muscles. Probably the most common condition from which muscular rheumatism must be differentiated is the muscle spasm associated with arthritis deformans. Poliomyelitis and neuritis must also be considered.

Treatment should be both local and general. Local treatment is more effective in the acute muscular rheumatism, and consists chiefly in light stroking massage. This must be directed against the hard masses in the muscle. Inunctions and hot applications are also helpful. In the more chronic forms, the foci of infection must be removed, and general upbuilding measures should be instituted. Hot baths several times a week are helpful. Occasionally histamine iontophoresis is beneficial. Foreign-protein shock is not of great value. Injection of bee venom and of similar substances has been helpful only in the treatment of aged individuals. Daily exercises, in which the larger muscle groups are used, hasten convalescence.

The author is apparently writing from a wide experience. Muscular rheumatism is a rather discredited diagnosis in most American clinics today much as is that of fibrositis in English medicine, and it probably masquerades here under a number of medical names. Dr. Lange's book is practical and timely and should help in the diagnosis and treatment of many neglected disabilities of the muscles.

**MALADIES OSSEUSES. MALADIE DE RECKLINGHAUSEN, MALADIE DE PAGET, LIPOIDOSES OSSEUSES, MYELOMES MULTIPLES.** (Bone Diseases. Recklinghausen's Disease, Paget's Disease, Osseous Lipoidosis, Multiple Myelomata.) Dr. I. Snapper. Translated from the Dutch by Prof. F. de Witte and Dr. G. Coryn. Paris, Masson et C<sup>ie</sup>, 1938. 330 francs.

In this remarkable work on bone diseases, Prof. Snapper has given the results of his study of Recklinghausen's and Paget's diseases, osseous lipoidosis, and the multiple myelomata. The grouping of these four distinct conditions, which present so close a resemblance both clinically and pathologically, makes a most important and interesting contribution.

In the chapter on Recklinghausen's disease the part played by the parathyroids naturally is given a prominent place. The author calls attention to the fact that, dating from 1926, when Mandl reported the finding of a parathyroid adenoma in a case of Recklinghausen's disease, the excision of which resulted in clinical cure, there has been a new interest in the problem of the interdependence of the parathyroids and bone diseases. The development of the knowledge of these glands up to the present forms an interesting and valuable introduction to this subject. Every phase in the relation of these glands to the subject is considered before the pathology, the diagnosis, and the roentgenographic changes of osteitis fibrosa cystica are discussed. Illustrations of treated and cured cases clearly demonstrate the therapeutic problems. Photomicrographs and roentgenograms before and after treatment illustrate the encouraging and remarkable results which may be hoped for. At the end of the chapter is a concise résumé of the essential points. This same plan of summarizing the outstanding facts is followed in each of the other chapters.

There is a short chapter on the relation of hypertrophy of the parathyroids to the disturbances of the calcium metabolism, particularly of the influence of the calcium output on the parathyroids.

The clinical course of Paget's disease is very clearly described and illustrated by extraordinarily fine roentgenograms, and its relation to the calcium content and to osteitis fibrosa is given special attention. In the résumé it is stated that the condition should be regarded more as a symptom than as a disease, and that Paget's disease and Recklinghausen's disease are two distinct affections etiologically, clinically, and roentgenographically.

In the remaining chapters are discussed the other diseases which are similar to and may be confused with Recklinghausen's disease,—osseous lipoidosis (the xanthomata and Gaucher's disease) and multiple myelomata (Kahler's disease and the relation between the multiple myelomata and the leukaemias). The resemblances, both pathological and clinical, are pointed out, and the diagnostic evidence by which the distinctions between Recklinghausen's disease and the others are made are emphasized.

The illustrations are photographic prints, which bring out the important details to

an extent that is very seldom seen. A complete bibliography is appended to each chapter.

The book must be regarded as presenting material of unusual value with unexcelled illustrations.

**DER RHEUMATISMUS UND DIE STREPTOMYKOTISCHE SYMBIOSE. PATHOLOGIE UND THERAPIE.** (Rheumatism and the Streptomyotic Symbiosis. Pathology and Therapy.) Dr. med. Wolfgang H. Veil. Stuttgart, Ferdinand Enke, 1939. 73 marks.

Following the preface, the author devotes one chapter to a discussion of the concept of rheumatism, including a historical survey and a consideration of the multiplicity of modern theories in regard to this disease. In a description of external rheumatism, mention is made of muscular rheumatism, myogelosis, and hypertonia, together with the relationship of these processes to the nervous and vascular systems. Under the heading of systemic symptoms are discussed the occurrence of fever and the changes in the blood picture, including cellular and humeral reactions.

Approximately 400 pages are given to a description of the development of rheumatic disease, embracing the acute and the chronic processes. Among the latter are many affections which are a part of, or related to, rheumatism, such as articular disease, chronic rheumatic neuropathies, rheumatic encephalopathies, rheumatic neuropathies of the sympathetic nervous system, internal visceral disease, and metabolic dysfunction.

The text is supplemented by 173 illustrations, two colored plates, and five tables. The bibliography is mostly that of German authorities on the subject. More than 200 case reports are given.

In general, the subject of rheumatism is adequately covered, although, in accordance with the author's theory, certain features are emphasized to the exclusion of other well-known aspects of the disease. The author's objective is a consideration of the biological processes involved in the disease and the effects which these may have on the organism, rather than the description of the effects which are produced in isolated organs or localities of the body. Viewed from that standpoint, the book represents a well-planned and thorough study and is, therefore, to be recommended to those who are interested in the subject of rheumatism.

**ANEMIA IN PRACTICE.** William P. Murphy. Philadelphia and London, W. B. Saunders Company, 1939. \$5.00.

Dr. Murphy's book does not pretend to be a complete treatise on the anaemias. In the author's words it is an effort to present "those facts and methods which during the past few years have proved to be most useful and practical in my own study and treatment of the anaemic patient".

It is primarily a book concerning pernicious anaemia, for only about one-fifth is devoted to anaemias other than pernicious anaemia. In the past fifteen years Dr. Murphy has seen and treated personally 578 patients with pernicious anaemia. It would be unfortunate if the knowledge gained by such a remarkable experience were not transmitted to the medical public. Although pernicious anaemia is not as prevalent as certain other anaemias (the anaemia accompanying infection and iron-deficiency anaemia being much more common), it is a disease which responds to adequate, well-planned treatment in a very satisfactory manner. The correct method of treating such patients is not easily acquired. There are many tricks to the trade, many pitfalls of diagnosis and complications which require intimate knowledge.

Hematologists are perhaps exceptionally critical of each other's conclusions, but they are certain to take exception to some of Dr. Murphy's points of view. It seems confusing to describe all types of hypochromic anaemia as one disease process, and particularly not to separate iron deficiency from other types of hypochromic anaemia. Such nomenclature harkens back to the term "secondary anaemia" which has largely lost its significance. Deficiency of thyroxin does not belong strictly to the group of "nutritional



anaemias". It would be important if liver extract and iron really assisted regeneration of the blood in Hodgkin's disease and in leukaemia after roentgen-ray therapy. It is the usual experience that x-ray therapy alone often alleviates the anaemia in these diseases. It is doubtful that liver extract intramuscularly assists the regeneration of blood produced by iron administration in iron deficiencies, or that it assists the beneficial effect of vitamin C or of thyroxin in anaemias due to deficiencies of these substances. Most hematologists would doubt the efficiency of liver and iron in the therapy of hemolytic jaundice. The giving of iron and liver in cases of nearly all types of anaemia at least has the attribute of thoroughness, but it is not in line with modern thought on the specificity of anaemias and their treatment by specific means. Dr. Murphy stands almost alone in doubting the greater efficacy of ferrous salts over ferric salts.

The descriptions of the earliest treatment of pernicious anaemia with liver preparations are extremely interesting and illuminating. The discussion of complications is a noteworthy section. Dr. Murphy found that 138 patients out of 578 had hypertension, an incidence much higher than that found by other workers. He suggests that liver extract may have some specific effect in angina pectoris. Diaphragmatic hernia was found in five of his patients. Carcinoma was probably more common than in a similar age group without pernicious anaemia and was present in twenty-nine cases. Carcinoma of the stomach, however, was present in only four cases. Disease of the gall bladder was extremely common (sixty cases).

There is included a complete account of the laboratory procedures useful in the diagnosis and differential diagnosis of pernicious anaemia, a useful description of the method of giving liver extract intramuscularly, and one of the method of giving citrate transfusion. An error should be corrected on page 289: The color index is obtained by dividing the percentage of the normal hemoglobin level by the percentage of the normal erythrocyte level.

There are a few amusing and clarifying cartoons. The few colored plates of blood smears seem poorly chosen in view of the enormous material which must have been at the author's disposal. The reviewer took pains to measure the average diameter of the red cells in the three plates of hypochromic anaemia, hemolytic anaemia, and pernicious anaemia. The mean diameter of the red cells in each was almost identical, whereas actually it is quite different in the three diseases.

The book is written in readable, informal style. It should be pleasant and profitable reading for physicians and for some patients. Dr. Murphy, with years of practice in treating successfully pernicious-anaemia patients and with much experience in teaching and demonstrating to undergraduate and graduate students, has been enabled to produce a book of distinct, clinical value to practitioners.

DIE KREUZSCHMERZEN DER FRAU. IHRE DEUTUNG UND BEHANDLUNG. GYNÄKOLOGISCHE ORTHÖPADIE. (Sacral Pain in Women. Its Significance and Treatment. Gynecological Orthopaedics.) Prof. Dr. Heinrich Martius. Leipzig, Georg Thieme, 1939. 7.50 marks.

In this scholarly monograph the author discusses the subject of sacral pain in the female as a symptom not merely of gynecological disorders but of orthopaedic disabilities, or of both. Under the first caption, he considers uterine retroversion and retroflexion, procidentia, endometriosis, dysmenorrhoea, parametritis and other infections, chronic obstipation, varicosities, and pelvic tumors, all of which may be symptomatized by sacral backache. Under the second heading, he discusses functional postural anomalies (ptosis and flat-foot), and organic structural disabilities such as sacralization of the left lumbar vertebra, lumbarization of the first sacral vertebra, spina bifida occulta, spondylolisthesis, lumbar and lumbosacral arthrosis and osteo-arthritis, sacro-iliac arthritis and trauma, and osteomalacia. Clinically he describes two different sacral-backache syndromes, whose observation he believes may be of great significance and value in differential diagnosis between pelvic and orthopaedic types of disability. He describes also his method of treatment by posture support, and develops a gynecological orthopaedics

designed to meet both the reproductive and the mechanical problems associated with the structural and organic disabilities of the bony pelvis and of its visceral contents.

**CHONDROMALACIA OF THE PATELLA.** Nils Silfverskiöld. *Acta Orthopaedica Scandinavica*, IX, 214, 1938.

On the basis of 170 serial autopsies and seventy personal operations, the writer discusses degeneration of the patellar cartilage, "the most common of the internal derangements of the knee joint". Retropatellar crepitation, the most important symptom, can be accurately localized by palpation. Effusion may mask the crepitation. Peripatellar tenderness and pain on kneeling are important findings.

The lesion begins at the center of the cartilage with yellow discoloration and softening. Superficial cracks and a peripatellar synovitis appear. With advance of the disease, bone is exposed centrally, and peripatellar osteophytes appear.

Limitation of activity will control the mild case. Operation through a median parapatellar incision, with excision of the affected cartilage, is indicated when the changes are more marked. Patients with advanced generalized osteo-arthritis of the knee are not operated upon, but localized osteophytes may be cut away with advantage.

Forty-three postoperative cases are reported in detail. No patient could endure excessive activity: 40 per cent. were fit for ordinary physical work; in 26 per cent. lighter work caused no reaction; and in 34 per cent. there was improvement, but pain and swelling developed on exertion.—*W. P. Blount, M.D., Milwaukee, Wisconsin.*

**DIE KORRELATION (KOPPELUNG) VON MISSBILDUNGEN, ERLÄUTERT AM BEISPIEL DER AKROCEPHALOSYNDAKTYLIE** [The Correlation (Coupling) of Malformations, Illustrated by the Example of Acrocephalosyndactylia]. B. Valentin. *Acta Orthopaedica Scandinavica*, IX, 235, 1938.

The subject of correlated (coupled) malformations as illustrated by acrocephalosyndactylia is discussed and differentiated from (1) the syndrome or symptom complex (club-foot with spina bifida) and (2) system malformations (osseous-system cleidocranial dysostosis).

Seven personal cases of acrocephalosyndactylia are reported in detail with eighty-three from the literature. Abortive and transition forms occur, as when only one or both hands show syndactylia without involvement of the feet or the skull. Numerous variations are cited, together with other malformations of the extremities correlated with defects of the skull, the face, and the eyes. Various theories of causation are discussed.

In spite of careful search, no case of acrocephalosyndactylia could be found in which there had been familial occurrence of the same deformity. In this it differs from other correlated malformations.—*W. P. Blount, M.D., Milwaukee, Wisconsin.*

**EWING'S TUMOR SIMULATING SARCOMA OF SOFT-TISSUE ORIGIN.** Henry Potozky and Jacob R. Freid. *The American Journal of Cancer*, XXXVI, 1, May 1939.

Four cases of Ewing's tumor, in which roentgenographic examination of the affected bone did not reveal any pathology, are described. Three of the tumors, however, occurred in flat bones (scapula, clavicle, and sacrum) in which slight changes in structure are difficult to demonstrate roentgenographically. The greater part of the tumor growth appeared to occur outside the bone, and a soft-tissue origin was suspected in each case. The tumors regressed after radiation therapy, but subsequently recurred and metastasized.

In each of the four cases the tumor occurred in an adult. In the final analysis, unquestionable proof that the tumors arose in bone cannot be adduced. The clinical evolution of the cases and the histological studies were regarded as in favor of the diagnosis of Ewing's sarcoma. It is necessary to admit, however, that we lack knowledge of the potentialities of evolution of uncontrolled round-cell tumor of the soft parts.

There are excellent roentgenograms and photomicrographs of these cases.—*Grantley W. Taylor, M.D., Boston, Massachusetts.*

EXAMINATION OF THE INJURED BACK. John D. Ellis. *The American Journal of Surgery*, XLII, 561, 1938.

The author reviews the methods of examination of the spine and its supporting structures, including his experience and the findings of various physicians. He reviews the work of Yeomans in regard to the relation of the piriformis muscle and sciatic pain and coccygodynia. Reference is made to Steindler's study of the differentiation of painful areas and their relation to the back disability by the use of procaine injections. The author finds that the combination of symptoms and signs in low-back injuries is usually characteristic of the various lesions. He wisely states that no one sign is characteristic of any type of injury. In malingering cases, it has been found that no patient, on repeated examination, can possibly maintain a constant limitation of motion and positive signs, nor can simulation of functional disturbances correspond to pathology found at physical and roentgenographic examinations.

The author stresses the importance of roentgenographic examinations, including oblique lumbar views, to clear up the possibility of disturbances of the intervertebral foramen and of pathology of the apophyseal joints, and the fact that lumbosacral lesions are a more frequent cause of disability than lesions of the sacro-iliac joint.—*Custis Lee Hall, M.D., Washington, D. C.*

THE EFFECT OF TRAUMA ON THE MECHANICALLY WEAK BACK. Thomas P. Goodwyn. *The American Journal of Surgery*, XLII, 577, 1938.

The author discusses the patients with congenital or developmental abnormalities or deformities of the lumbar and sacral regions. These may be a source of pain in the low back when aggravated by injuries or when affected by toxæmic conditions. Disability can result without injury in the presence of these anomalies, and the evidence of irritation does not prove that injury has existed.

Operative fusion is described with reference to the series of patients from the New York Orthopaedic Hospital. Eighty per cent. of those operated upon were entirely relieved and improvement was obtained in the remaining patients in the series.

The author also feels that in every instance back pain and slipping of the disc must be considered. Caution in the use of lipiodol is urged.—*Custis Lee Hall, M.D., Washington, D. C.*

DIAGNOSIS AND TREATMENT OF ACUTE AND CHRONIC BACK PAIN DUE TO TRAUMA. C. R. G. Forrester. *The American Journal of Surgery*, XLII, 582, 1938.

The author recognizes four types of back injury: (1) true back injuries of the acute and chronic variety; (2) neurotic backs; (3) malingering backs; (4) pathological backs.

These types are reviewed and differentiated, with the description of a number of cases in which the patients were relieved by back wrenching under general anaesthesia. It is believed that the back-wrenching methods should be attempted in all cases of low-back pain which are definitely not pathological. The author makes a plea for this conservative method of treatment in view of the present-day trend for more radical procedures.—*Custis Lee Hall, M.D., Washington, D. C.*

TRAUMA OF THE COCCYX AND COCCYGODYNIA. Monte Edwards. *The American Journal of Surgery*, XLII, 591, 1938.

The author, in an excellent table, summarizes the methods of treatment used by various authors and the percentage of patients entirely relieved by these procedures and of those who were only partially and incompletely cured.

The methods are those of conservative treatment, massage, injection, and excision. The author feels that, because of the frequent failure of excision to effect a cure, conservative measures should be tried for longer periods than is generally the practice.—*Custis Lee Hall, M.D., Washington, D. C.*

A PLEA FOR CONSERVATISM IN FUSING OPERATIONS ON THE SPINE AND PELVIS. G. W. N. Eggers. *The American Journal of Surgery*, XLII, 595, 1938.

The author feels that before a patient is eligible for fusion operation, he should receive careful investigation and accurate diagnosis, and that the young and the old are not suitable subjects for fusion procedures. This necessarily narrows the group of fusion operations to a smaller number in which the results would be satisfactory. He makes a plea for fewer fusions in traumatic cases and for more bed rest and support to the injured spine.—*Custis Lee Hall, M.D., Washington, D. C.*

RECURRENT DISLOCATION OF THE SHOULDER. Marcus H. Hobart. *The American Journal of Surgery*, XLIII, 279, Feb. 1939.

The definition, etiology, pathology, symptomatology, and treatment of recurrent dislocation of the shoulder are reviewed. In the initial dislocation, there is usually a history of severe trauma, followed by inadequate subsequent treatment. The operation should be suited to the type of lesion and to the individual's habits. Recent correspondence with men who have presented articles on the subject is recorded. The Nicola operation seems to be regarded with favor in the average case, although in special cases some surgeons recommend operative procedures which they have devised. A combination of the Nicola and the Clairmont operations is described by the author for patients whose occupations or sports subject them to severe trauma.—*O. Anderson Engb, M.D., Washington, D. C.*

TREATMENT OF SUBDELTOID BURSITIS. Mark H. Rogers. *The American Journal of Surgery*, XLIII, 292, Feb. 1939.

Subdeltoid bursitis is divided into three types: (1) the acute case, of sudden onset; (2) the chronic adhesive type with the so-called frozen shoulder, of slow onset; and (3) the traumatic type, in which there is a history of slight trauma. The treatment varies with the type. In the acute cases, physical therapy or surgical drainage is of value. The chronic form is treated conservatively for two weeks and, if satisfactory progress is not taking place, careful manipulation under anaesthesia is performed. The traumatic group is divided into the milder cases with little involvement of capsule, tendon, or bursa, and the more severe cases with loss of active abduction. The latter cases demand operative repair of the muscle and tendon.—*O. Anderson Engb, M.D., Washington, D. C.*

BRACHIAL BIRTH PALSY. Beveridge H. Moore. *The American Journal of Surgery*, XLIII, 338, Feb. 1939.

The author does not feel that the problem of brachial birth palsy has been solved by any means. By the time the orthopaedic surgeon sees the case, the primary pathological changes are beyond repair and, therefore, he must concern himself with prevention or correction of the secondary pathological changes. The instability of the shoulder joint makes most procedures unsatisfactory. The correction of contractures is the easier part of the treatment. Most splints cannot maintain the arm in abduction and in external rotation and at the same time keep the head forward in the glenoid cavity. The author uses a special brace of his own design for such a position. Of all the operative procedures, the Sever is generally his choice, although the Kleinberg operation or osteotomy procedures are used in some cases. The author uses a portion of the intact acromial and clavicular divisions of the deltoid as an external rotator by transplanting it into the scapular spine.—*O. Anderson Engb, M.D., Washington, D. C.*

SPONDYLOLISTHESIS: SUGGESTIONS FOR TREATMENT. Walter Mercer. *The American Journal of Surgery*, XLIII, 367, Feb. 1939.

Spondylolisthesis may be defined as a forward subluxation of the body of the fourth or fifth lumbar vertebra, together with the superimposed vertebrae, on the vertebra be-

low or on the sacrum. Increasing experience tends to confirm the opinion that it is primarily the result of a congenital cleft in the laminae of the neural arch, and this has been a constant finding in every specimen of spondylolisthesis studied. The break in continuity occurs between the superior and inferior articular processes, releasing the body of the vertebra with its superimposed column, which together slip forward. Mercer describes the clinical picture and roentgenographic appearance and gives a differential diagnosis. The mere discovery of the condition, he says, in discussing treatment, does not indicate a major operation, but primary treatment should be that of any postural backache. Strenuous occupation or exercise should be prohibited; a period of rest should be instituted; and some form of supporting brace should be applied in some cases. Surgery, using an anterior graft, is necessary in certain cases.—O. Anderson Eng, M.D., Washington, D. C.

**SPINA BIFIDA.** Robert S. Smith. *The American Journal of Surgery*, XLIII, 379, Feb. 1939.

Three forms of posterior spina bifida are described: (1) rachischisis, (2) spina bifida cystica, and (3) spina bifida occulta. An early plastic procedure to repair the spinal hernia is necessary in frank spina bifida cystica. Later, further treatment of a reconstructive nature may be indicated to correct deformities and functional disturbances. Spina bifida occulta, which is quite a common condition, often presents marked disabilities and disturbances in function, especially during adolescence. Laminectomy gives relief in many cases. The problems encountered in spina bifida require the help of the neurosurgeon and the urologist as well as the orthopaedic surgeon. The author presents some interesting case reports.—O. Anderson Eng, M.D., Washington, D. C.

**THE OPERATIVE CORRECTION OF EXTERNAL ROTATION CONTRACTURE OF THE HIP.** Michael S. Burman. *The American Journal of Surgery*, XLIII, 414, Feb. 1939.

This deformity is due to soft-tissue contracture. The gluteus maximus, acting as an abductor, together with the short external rotating muscles of the thigh, is responsible for this condition. Division of the contracting tendons and the after-care are described. This operation can be used in place of a bone operation in some cases.—O. Anderson Eng, M.D., Washington, D. C.

**LEG LENGTHENING.** George Anopol. *The American Journal of Surgery*, XLIII, 422, Feb. 1939.

Leg lengthening is more physiological than leg shortening. The author describes a method, using an original apparatus in which the turnbuckle principle is utilized. The osteotomy of the lengthened bone is illustrated. Gradual lengthening by turns of one thirty-second of an inch is necessary, because rapid distraction traumatizes tissues. The method has been used in patients between eleven and thirty-six years of age, with an average total increase of two and three-fourths inches. The part is encased in plaster during the lengthening.—O. Anderson Eng, M.D., Washington, D. C.

**CRUCIAL LIGAMENTS.** A RÉSUMÉ OF OPERATIVE ATTACKS AND RESULTS OBTAINED. William R. Cubbins, James J. Callahan, and Carlo S. Scuderi. *The American Journal of Surgery*, XLIII, 481, Feb. 1939.

Following complete dislocation of the knee joint, immobilization is indicated for at least four months. Some patients will then recover without operation. Early repair is contra-indicated. However, if a single ligament is ruptured, an early operation should be done. Regeneration of cruciate ligaments following rupture may not occur, and in cases of double cruciate rupture, no traces have been present. The authors describe their

methods of repair. They advise an accurate determination of the abnormal movements of the tibial plateau upon the femoral condyle and also recommend an adequate incision for a careful and complete inspection of the joint. The use of fascia lata in these newly transplanted cruciate ligaments has given satisfactory results.—*O. Anderson Engh, M.D., Washington, D. C.*

**DISLOCATIONS OF THE KNEE JOINT.** H. Earle Conwell. *The American Journal of Surgery*, XLIII, 492, Feb. 1939.

Ligaments prevent many dislocations, because of their strength. Seven cases of complete dislocations have been seen by the author. Complete dislocations are classified as follows: (1) anterior, (2) posterior, (3) lateral, (4) medial, and (5) rotary. Anterior dislocation is the most common type. Diagnosis of complete dislocations is easy. However, roentgenograms should be taken to rule out fractures. Early splinting and closed reduction are indicated. Compound dislocations require thorough débridement. A cast should be applied for from six to eight weeks. Amputation is rarely necessary in these cases. The circulation should always be closely observed during and after reduction.—*O. Anderson Engh, M.D., Washington, D. C.*

**ARTHROSCOPY IN THE DIAGNOSIS OF MENISCAL LESIONS OF THE KNEE JOINT.** Leo Mayer and Michael S. Burman. *The American Journal of Surgery*, XLIII, 501, Feb. 1939.

"Arthroscopy is the endoscopic visualization of a joint. Its technique is simple, but interpretation of findings must be based on cadaver experimentation and clinical experience." One hundred and thirty patients have been examined by this method. The disadvantage of this method is that the infrapatellar fat pad interferes with visualization of the menisci. The middle part can be seen best. The author discusses important points in the technique. The value of arthroscopy in meniscal lesions lies not only in detection of the actual meniscal lesion, but in the discovery of other associated lesions. These include erosion of the femoral condyle and injury of the anterior cruciate ligaments, fat pads, and synovial membrane. The important advantage of arthroscopy is its simplicity. Further experience is giving increasing accuracy in interpretation.—*O. Anderson Engh, M.D., Washington, D. C.*

**RESTORATION OF MOTION IN FIBROUS ANKYLOSIS OF THE KNEE WITH THE DESCRIPTION OF A NEW APPARATUS.** Robert L. Preston. *The American Journal of Surgery*, XLIII, 519, Feb. 1939.

The term "fibrous ankylosis of the knee" designates limited passive motion of the joint, which results from fibrous adhesions between the gliding surfaces of the joint or periarticular structures. The knee joint is susceptible because of its complex structure and mechanics. Adhesions may be (1) intra-articular, (2) periarticular, (3) in the muscles controlling the joint, and (4) in the skin and subcutaneous tissue. Before restoration of motion is attempted, a search for active inflammation must be made. Conservative and operative measures are described. The type of treatment depends on the pathology present. In the more severe cases, the hazards can be avoided by the use of open surgery. An original apparatus, called the screw-control knee brace, is described. It is of value in stretching adhesions and in preventing recurrence of deformity following surgical treatment.—*O. Anderson Engh, M.D., Washington, D. C.*

**A NEW OPERATION FOR PRODUCING ANTERIOR OR POSTERIOR BONE BLOCK OF THE ANKLE.** Frederick G. Dilger. *The American Journal of Surgery*, XLIII, 532, Feb. 1939.

The operations designed for paralytic drop-foot may be classified under two general types: (1) construction of a check ligament, as done by Gallie, and (2) the construction of

a bone block, as done by Campbell, Putti, and Albee. The bone-block operations may be anterior or posterior. The author describes his own method, using a wedge graft from the tibia, and implanting it either anteriorly or posteriorly in the astragalus to prevent dropping. Diagrams and roentgenograms are used to show the method. The operation has been performed eleven times in the past two years, usually with other arthrodeses, with good results.—*O. Anderson Engh, M.D., Washington, D. C.*

**TYPHOID AND PARATYPHOID OSTEOMYELITIS.** J. Ross Veal. *The American Journal of Surgery*, XLIII, 594, Feb. 1939.

Typhoid osteomyelitis is a vanishing disease in America. Less than 1 per cent. of typhoid cases present bone lesions. Paratyphoid is closely related to typhoid and runs a similar course, but bone complications are exceedingly rare.

Arthritis is an occasional complication of typhoid fever, affecting the sternoclavicular and large joints most often. It is usually monarticular, occurring during the active stage of the disease, and is of the simple toxic variety. Subluxation is likely to occur if the hip is involved. Traction is used, and, if effusion develops, aspiration and irrigation are done. In suppurative joints, incision and flushing of the joint without drainage are advised. One of the frequent bone complications of typhoid fever is the "typhoid spine", characterized by backache and tenderness and showing thinning of the intervertebral discs as demonstrated by the roentgenogram, and is treated by rest and fixation of the spine. The common bone lesion of typhoid, however, is osteomyelitis, which involves the long bones chiefly. The diaphysis rather than the metaphysis is affected. Occurrence is months after onset of the generalized disease. The bone lesion is not characteristic, but it is usually single, well localized, and chronic in character. Dull, boring pain is present. Rest, immobilization, and vaccines are indicated, except in the suppurative stages, when surgery plus vaccines produce a cure.

Paratyphoid osteomyelitis is usually more acute than typhoid; it occurs earlier; it is more febrile; and it spreads more through the bone. The diagnosis depends upon the characteristic agglutination tests and identification of the organism from the blood stream or pus from the lesion. The treatment consists in incision and drainage, followed by autogenous vaccines.—*O. Anderson Engh, M.D., Washington, D. C.*

**THE SIGNIFICANCE OF THE CYSTINE CONTENT OF FINGER NAILS IN ARTHRITIS.** M. X. Sullivan. *The American Journal of Surgery*, XLIII, 620, Feb. 1939.

The author analyzed the fingernail clippings of twenty-six normal individuals and 103 arthritics for cystine. The following conclusions were drawn by the author as a result of these studies:

1. Fingernail analysis may contribute to the prognosis and the study of the effect of various treatments, since, with improvement in clinical condition, there is a tendency for the cystine content of the fingernails, when low, to return to normal.

2. Arthritis may occur with high or low cystine content of the nails.

3. Other diseases may show low cystine content of the nails.

4. The cystine content of the fingernails has no specific diagnostic value as far as arthritis is concerned.

5. In the sulphur metabolism, the animal body has a ready, though limited, defense against injurious agencies such as phenol, indole, cyanides, and possibly some amines.

6. The principal significance of the cystine content of the fingernails is that a low cystine content may indicate a weakened physical bank account and a lessened resistance to injurious agencies.—*O. Anderson Engh, M.D., Washington, D. C.*

**LA TUBERCOLOSI MUSCOLARE** (Tuberculosis of the Muscles). Benedetto Rossi. *Annali Italiani di Chirurgia*, XVII, 923, 1938.

The author reports a series of experiments concerned chiefly with tuberculosis of

muscle tissue. The experiments were performed on guinea pigs and rabbits, with bacillus tuberculosis of the human, bovine, and avian types. There was no difference in the lesions produced by these three types of bacilli. Inoculations of bacillus tuberculosis directly into the muscles produced semifluid areas of non-specific character. After intraventricular inoculation into the heart, no lesions could be found in the peripheral muscles. By intravenous injection, typical tubercles with giant cells were produced. These tubercles, however, were found only in the walls of the arteries of the muscles. The myocardial musculature reacted in a manner different from that of the peripheral skeletal musculature: direct inoculation as well as intravenous injection produced typical tubercles in the cardiac muscles.—*Josef Wolf, M.D., Davenport, Iowa.*

CONTRIBUTO SPERIMENTALE ALLA CHIRURGIA DEI TENDINI (Experimental Contributions to the Surgery of Tendons). Piero Bassi. *Annali Italiani di Chirurgia*, XVIII, 33, Jan.-Feb. 1939.

The author describes a series of experiments concerning the value of artificial tendon sheaths made of cellophane and of self-made films of collodium and celluloid. He ensheathed the Achilles tendons of domestic rabbits with these covers, then tested the ability of sliding and examined the tissues microscopically at different intervals after the operation. There was no difference between these substances in the reaction upon the tendon or the surrounding tissues. This reaction was very favorable; no signs of irritation were found. Even sixty days after the operation the tendon showed a perfectly smooth surface and good function. The author regards these substances as well suited for the prevention of adhesions in operations on tendons.—*Josef Wolf, M.D., Davenport, Iowa.*

HEMANGIOMA OF JOINTS. REPORT OF FIVE CASES. George E. Bennett and Milton C. Cobey. *Archives of Surgery*, XXXVIII, 487, March 1939.

Reporting five instances of hemangioma of the knee joint, Bennett and Cobey carefully review and tabulate the cases recorded in the literature. It is their belief that the tumor is congenital in origin. The mass is composed of bluish venous sinuses. It can be found in early life, commonly associated with intermittent swelling and pain, and it usually limits movement only at the extremes of the joint motion. Because unprepared incision into these tumors may lead to uncontrolled hemorrhage with its serious sequelae, it is advocated that careful diagnosis be made, and diagnostic criteria are enumerated. The treatment recommended for such pedunculated tumors is excision, and for the larger and more extensive growths, radium or roentgen therapy.—*I. William Nachlas, M.D., Baltimore, Maryland.*

INJURIES OF THE LIGAMENTS OF THE KNEE JOINT. AN EXPERIMENTAL STUDY. M. Thomas Horwitz. *Archives of Surgery*, XXXVIII, 946, May 1939.

The value of the cruciate ligaments in maintaining stability in the normal knee has been overrated. Indeed, it is the author's belief that most of the restoration of function in badly injured knees can be attributed to the healing of the collateral ligaments rather than to the repair of the cruciate ligaments. To help prove this impression, he subjected eight rabbits to experimental severance of the tibial collateral ligaments, and eight rabbits to incision of the cruciate ligaments. The animals were sacrificed after from two to twelve weeks and the repair processes were studied. It was found that the tibial collateral ligaments were restored in their continuity, even when a definite gap had been made, while the cruciate ligaments underwent a retraction of the severed edges with fraying and absorption of the free ends. In studying the effect of forcible abduction of the knees of human cadavers, it was observed that the tibial collateral ligaments generally tore at or near their bony attachments.—*I. William Nachlas, M.D., Baltimore, Maryland.*



OPERATION FOR FRACTURE OF THE OLECRANON. Naughton Dunn. *British Medical Journal*, I, 214, Feb. 4, 1939.

Two cases are reported in which this fracture was treated by removal of the detached portion of the olecranon, and by repairing the triceps tendon and its expansion. The first case was complicated by fractures of the radius, the ulna, and the humerus, and these prevented the usual treatment of the olecranon fracture. Full functional recovery took place. The second case, that of a male of sixty-seven, was treated by removal of the olecranon, and by splinting the elbow at 120 degrees of extension for ten days. Three weeks after the operation, the patient was using a cross-cut saw.—James W. Toumey, M.D., Boston, Massachusetts.

REFERRED PAIN FROM BONE POINTS. Raffaele Bastianelli. *British Medical Journal*, I, 491, March 11, 1939.

In many cases with pain, even over a large area, a point may be found over a bone at which pressure will elicit the pain. A typical bone point is to be found on the head of the humerus under and a little to one side of the coracoid process. Other common tender points in the upper extremity are the medial epicondyle of the humerus and the tip of the styloid process of the radius. From the limited tender point the pain may spread widely. Typical tender bone points in the lower extremity are the medial condyle of the femur, the apex of the patella, and the medial side of the navicular. Many so-called metatarsalgias are due to painful bone spots on the metatarsals. Tender bone spots are frequent on the tips of the spinous processes of the vertebrae and on the posterior ilium. The morbid anatomy is unknown. Small chips of bone excised with the periosteum have never shown structural change. The treatment is local injection of novocain. If unsuccessful, injection of from ten to twenty drops of 3:100 carbolic solution is employed exactly on the bone spot.—James W. Toumey, M.D., Boston, Massachusetts.

OSTEOCHONDROBLASTOMA METACARPAL PRIMITIVO (Primary Osteochondroblastoma of a Metacarpal). Manuel A. Manzanilla. *Cirugia y Cirujanos*, VII, 233, 1939.

The author reports a case of primary osteochondroblastoma of a metacarpal in a male, seventy-five years of age. This type of malignant neoplasm is rare, and its localization in a metacarpal is infrequent. After describing the clinical course and treatment, the author calls attention to the usefulness of a roentgenographic study in establishing the diagnosis, the importance of an anatomopathological study in determining the benignancy or malignancy of a tumor, and the existence of divergencies in the clinical character of the tumor with respect to benignancy or malignancy. He advises caution in interpretation of the morphological phenomena, and concludes that the essentials of cancer surgery are wide excision, experience, and judgment.

ABSORBABLE METAL IN BONE SURGERY. A FURTHER REPORT ON THE USE OF MAGNESIUM ALLOYS. Earl D. McBride. *The Journal of the American Medical Association*, CXI, 2464, 1938.

This paper is a further report upon the use of magnesium alloys in bone surgery. In osseous tissues the serum salts attack the metal readily, and the formation of gas may be seen as early as forty-eight hours after insertion. The appliances made of this metal are best suited to cases in which small metal screws and pins may be efficiently used.

Magnesium alloys employed in bone fixation have no systemic effect upon the body. There is a definite electrolytic action, easily demonstrated by an ammeter. This may stimulate periosteal proliferation and callus formation. No change is seen in the articular cartilage except that due to the trauma of penetration. The absorption of the metal is in proportion to the amount of serous fluids in contact with it. Thus, in traumatized tissue and in softened bone fragments, the absorption rate is accelerated. Roentgenographic

study may show an apparent cystic bone formation, but a collection of gas bubbles near the metal is responsible for such misinterpretation.

The gas which forms in the tissues about the metal has proved to be chiefly nitrogen. It is pointed out, however, that a high percentage of hydrogen is also formed, but this is readily absorbed. Simple release by aspiration or by puncture has produced no complications.—*H. M. Childress, M.D., Dallas, Texas.*

**COCCIDIOIDAL OSTEOMYELITIS.** Paul E. McMaster and Charles Gilfillan. *The Journal of the American Medical Association*, CXII, 1233, April 1, 1939.

Both the surgical and pathological aspects of bone and joint involvement by the fungus *coccidioides immitis* are discussed. The organism gains entrance through the skin or the respiratory tract. Twenty-four cases are reported. The average age of the patients was thirty-two years. Thirteen of the patients died and each had an associated pulmonary focus. Most of these patients came from the San Joaquin Valley, which seems to be an endemic region.

The coccidioidal foci of bones in patients who died from the acute form of the disease showed gross necrosis and abscess formation. The cortex may be destroyed with an associated soft-tissue abscess. In the chronic form, abscess formation is found, and the cavity is filled with granulation tissue with or without "bone sand"; larger sequestra are sometimes found. The surrounding bone may appear hyperaemic or irregularly sclerotic. Examination of infected joints reveals a grayish, thickened synovia. It is assumed from microscopic studies that coccidioidal pus has no direct destructive action on either bone or cartilage, but that they are destroyed by direct cellular activity of the granulation tissue. The more common, chronic bony lesions show coccidioidal granulation tissue, which is composed of round cells, histiocytes, Langhans's giant cells, and coccidioidal spherules. The roentgenographic picture depends on the stage of the disease and the virulence of the organism. In the early, acute stage the lesions are primarily destructive, with little or no surrounding bone production and little, if any, periostitis. The chronic form shows a destructive type of lesion with bone production and usually an overlying ossifying periostitis. Lesions usually occur in regions of cancellous bone. Foci in the long bones occur at or near the end.

Treatment is of both a general and local nature, particularly when there is an associated pulmonary infection. In the early or acute cases treatment is immobilization of the affected bone or joint. When abscess formation is present, it should be drained and the bone saucerized, packed with sterile vaselin gauze, and placed in plaster-of-Paris according to the method of Orr. Joint cure by ankylosis is usual, and treatment should be carried out with this in mind. There is no specific medication of proved value—*Henry H. Beckering, M.D., Dallas, Texas.*

**SUBCAPITAL FRACTURES OF THE HIP. WHY DO NOT THESE UNITE AS OTHER FRACTURES?** Fred H. Albee. *Journal of the International College of Surgeons*, II, 15, Jan.-April 1939.

When the upper end of the femur is broken directly beneath the head, the fracture force, or its attendant muscle spasm, causes a forcible rolling of the capital fragment in the acetabulum, so that the ligamentum teres is torn. This theory is substantiated by the operative finding of the rupture of the ligaments in 417 of 419 cases. The same displacement of the small fragment produces a rupture of the retinacula. Furthermore, the intracapsular character of the fracture leads to the introduction of callus-inhibiting synovial fluid. These three factors cause a circulatory isolation of the head, which is responsible for the high percentage of non-unions, even in cases where satisfactory reduction and immobilization have been obtained. To afford a means of conduction for the necessary blood supply to the isolated head as well as to provide an osteogenic influence and means of fixation for the reduced fragments, it is recommended by Albee that a

tibial bone-graft peg, at least one-half an inch in diameter, be used for such fractures.—  
*I. William Nachlas, M.D., Baltimore, Maryland.*

A RECONSTRUCTION OPERATION FOR PSEUDARTHROSIS AND RESORPTION OF THE NECK OF THE FEMUR. J. V. Luck. *The Journal of the Iowa State Medical Society*, XXVIII, 620, 1938.

The author states that this operation was designed to free the upper femur from the devastating action of shearing stress in ununited fractures of the neck of the femur. The strong upward pull of the glutei, the psoas, and the thigh adductors has a part in producing this stress. The weight of the body also causes a downward shear on the femoral neck. It is the author's opinion that, had these forces been successfully dealt with in the original treatment, the pseudarthrosis would not have occurred. The technique resembles somewhat the Brackett and the Voss-Thompson-Stephens reconstruction operations and the Lorenz and Pauwels osteotomies. In this operation, a bed, free from shearing stress, is prepared in the intertrochanteric region for the fracture surface of the femoral head. The end result gives only a pressure stress.—*M. Jacobs, M.D., Iowa City, Iowa.*

LEITSÄTZE ZUR ÄRZTLICHEN VERSORGUNG DER ZUFALLSWUNDE (Directions for Medical Care of Traumatic Wounds). *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, XLVI, 1, Jan. 1939.

Principles for the care of open traumatic wounds were formulated by the following members of the *Deutsche Gesellschaft für Unfallheilkunde*: Geheimrat Prof. Dr. König, Würzburg; Prof. Dr. Schmieden, Frankfurt a.M.; Prof. Dr. zur Verth, Hamburg; Prof. Dr. Heller, Leipzig; Prof. Dr. Magnus, Munich; Prof. Dr. Böhler, Vienna; Prof. Dr. Bürkle de la Camp, Bochum.

The care of all wounds, except such as are obviously non-septic, demands complete excision of the wound surfaces within from six to eight hours after the injury. In cases where it seems advisable, this may be followed by suture of the wound. Wounds with swellings and pockets must be drained. This is followed by complete and uninterrupted immobilization.

The danger of tetanus infection is slight in most localities in Germany. Where suspicion of such infection exists, the wound must be completely excised, followed by the administration of antitoxin.

Gas-bacillus infection is apparently rare in times of peace. Where it occurs, it demands most careful excision of the wound and drainage. The question of serum treatment is unsettled.—*R. J. Dittrich, M.D., Fort Scott, Kansas.*

KNOCHENTUBERKULOSE UND TRAUMA (Bone Tuberculosis and Trauma). H. F. O.

Haberland. *Münchener medizinische Wochenschrift*, LXXXV, 1257, 1938.

In an attempt to arrive at some conclusion as to the possible relationship between bone tuberculosis and trauma, the author sent a questionnaire to 180 physicians, including surgeons, pathologists, specialists in tuberculosis, and general practitioners. The answers received showed that the majority believed that a relationship between trauma and tuberculosis is possible. A few considered it a remote possibility, and two pathologists stated that the relationship is improbable. Böhler, during the past twelve years, has treated 80,000 fresh fractures and has not found one case of tuberculosis following fracture. The author, in some interesting animal experimentation, came to the conclusion that a latent tuberculous focus of bone can become manifest through a traumatic injury, but a primary focus does not occur as a result of the trauma.—*T. L. Grelman, M.D., Iowa City, Iowa.*

**DIE COXA VARA; IHR KLINISCHES BILD UND IHRE HEUTIGE BEHANDLUNG** (The Clinical Picture and Present-Day Management of Coxa Vara). Max Lange. *Münchener medizinische Wochenschrift*, LXXXV, 1637, 1938.

Besides the symptomatic form of coxa vara (poorly united fracture of the femoral neck), there are three types of coxa vara in which the deformity is the entire clinical entity,—the congenital, the rachitic, and the type caused by some internal secretory disturbance. In discussing this entity, the author classifies the cases in four groups: (1) the infant, (2) the child, (3) the school child, and (4) the adolescent.

The prognosis and management of the individual groups differ widely. In general, if coxa vara is recognized early, it can be overcome and later complications prevented by conservative measures; in the severe advanced cases the deformity can be corrected by operative means. Pitzen once listed the operative procedures for coxa vara and found twenty-two. This would indicate that an entirely satisfactory method has not yet been found. The author, therefore, proposes an osteotomy in which three wedges are removed and the resulting cavity is large enough to take the projecting portion of the lower fragment. This maneuver requires that the femur be brought into abduction. Before the operation the abductor should be tenotomized. The results of this operation have been good. The angle is restored; the range of motion is improved; there is only a slight limp; and weight-bearing is good.—*T. J. Grectman, M.D., Iowa City, Iowa.*

**COMMON INJURIES INVOLVING THE KNEE JOINT.** Louis H. Edmunds. *Northwest Medicine*, XXXVIII, 85, March 1939.

This is an excellent discussion of the anatomy and kinesiology of the knee joint, together with a description of the most common injuries and their treatment. On the whole, the author advises conservative treatment, but operation on injured cartilages, which continue to give symptoms, should not be delayed too long, because of the danger of permanent derangements.—*Charles Lyle Hawk, M.D., Los Angeles, California.*

**SILK SUTURE MATERIAL.** Edwin A. Nixon. *Northwest Medicine*, XXXVIII, 131, April 1939.

The author gives an interesting account of the history of suture materials. Today, many surgeons are using silk in preference to gut in both bone and soft-tissue work; and they claim fewer infections and greater strength of the wound and usually more rapid healing. Silk has even been used in infective cases, and good results were claimed, but the author's experience in such cases has been discouraging. He presents photomicrographs showing greater tissue and cellular reaction in wounds sutured with gut than in silk-sutured areas. He advises the use of silk only in clean cases.—*Charles Lyle Hawk, M.D., Los Angeles, California.*

**ARACHNODACTYLIA.** H. J. Wyckoff. *Northwest Medicine*, XXXVIII, 134, April 1939.

This is a very good description of three of these interesting cases,—a male aged seventeen and two females aged fourteen and fifteen. There appear to be only twenty-five previous cases reported in the English literature, and the numerous cardinal points in diagnosis are brought out. Interesting illustrations of the author's cases are shown.—

*Charles Lyle Hawk, M.D., Los Angeles, California.*

**L'ASPECT RADIOLOGIQUE DES ENCOCHES DU CORPS VERTÉBRAL DE L'ENFANT. SON SUBSTRATUM ANATOMIQUE.** (The Roentgenographic Appearance of Vertebral Notches in the Infant. The Anatomical Substratum.) Pierre Passebois et Pierre Bétoulières. *La Presse Médicale*, XLVII, 280, February 18, 1939.

The lateral view of the thoracic vertebrae of children frequently presents a notching

of the anterior surface, as described by Hahn. The notching is found only in the thoracic vertebrae. It appears as early as the fourth or fifth month of life, reaches its maximum at about the twentieth month, and usually has disappeared by the sixteenth or seventeenth year of life. The disappearance of the notching invariably occurs first at the two extremities of the thoracic spine, the fifth, sixth, and seventh vertebrae being the last to manifest the condition.

In an effort to explain this appearance, the authors examined the vertebrae of a twenty-month-old infant. They found that the notching corresponded accurately to two flattened spheres of a brownish-red, friable tissue, which, on section, proved to be medullary tissue. A similar, though smaller area of this tissue, was found on the posterior aspect of the thoracic vertebrae. On either side of these two areas, the cancellous bone of the vertebral body assumed a butterfly shape.

The authors cannot explain the exact significance of this tissue, but they suggest that it may play a part in the mechanism of blood-cell production. They also suggest that the presence of this tissue may account for the fact that infection so frequently manifests itself first at these points.—*Henry Milch, M.D., New York, N. Y.*

LE TRAITEMENT DE L'OSTÉOMYÉLITE AIGUE DES ADOLESCENTS (Treatment of Acute Osteomyelitis in Adolescents). Pierre Petit. *La Presse Médicale*, XLVII, 284, February 22, 1939.

The author presents in rapid review the principles underlying the treatment of osteomyelitis in adolescents. Of the surgical methods suggested, incision of a periosteal abscess after localization is the simplest. Trepanation is of definite value only in cases of medullary abscess, but these form a relatively small percentage of the osteomyelitic affections. In the other cases, simple trepanation is apparently harmful. It does not adequately drain the diffuse inflammatory process and may serve to spread the infection. Many cases of relatively benign infection are transformed into malignant septicaemias. This applies with equal force to simple trephining or to the more extensive and shocking decortications and saucerizations.

In those cases in which such extensive operations are deemed necessary, subperiosteal resections seem to give better results. Subperiosteal resections may be classed as early or late. In the early resections, performed within several weeks of the onset of the affection, the periosteum is still supple, non-adherent, and shows no tendency to subperiosteal bone proliferation. If the resection is carried out after failure of a previous operation, it is classed as secondary; otherwise it is classed as primary.

The area to be resected should extend at least one centimeter beyond the limits within which stripping of the bone has occurred. If necessary, the whole diaphysis may be removed. Once the bone has been excised, the wound should be flushed with warm saline only. Under no circumstances should any antiseptics or drainage be used. The extremity is then immobilized in plaster-of-Paris. Bone regeneration is usually to be seen within the first two weeks and is usually complete within forty days.

Whatever the procedure which is adopted, the time of intervention is a matter of utmost importance. Because of the fact that the staphylococcus excites only a local tissue resistance and does not lead to a general immunity, the author is of the opinion that early intervention is harmful and may convert a local into a general infection by breaking down the barrier of tissue resistance. Plaster-of-Paris immobilization is, therefore, recommended as the method of choice in all cases of acute osteomyelitis, especially those with septicæmic manifestations. The strict immobilization permits the localization of the infective process concurrent with the sterilization of the blood stream. It is only when this localization has occurred that the surgical procedure previously discussed should be employed. In thirty-five cases treated by Leveuf according to these principles, there were no articular complications, and only one patient died as a result of a concomitant suppurative pericarditis.—*Henry Milch, M.D., New York, N. Y.*

LA DOLICHOSTENOMELIA (ARACHNOIDACTYLIA DOLICHOSTENIE SYNDROME DE MARFAN) Robert Clement *La Presse Medicale*, XLVII, 527, April 8, 1939

Dolichostenomelia, meaning long tapering extremities, is the larger classification within which the cases of arachnodactylia belong. This affection, first described in 1896, and since known as the syndrome of Marfan, is characterized by a general systemic participation.

The affection is apparently familial and hereditary in the direct line. It may be observed at birth, but assumes the most characteristic aspect between the ages of eleven and thirteen, and tends to become less prominent after puberty. In addition to the long tapering extremities and fingers, numerous other anomalies are present. Kyphosis alone, or combined with scoliosis, is frequent. Dislocation of the crystalline lens and other ocular malformations are typical. Anomalies of the heart and lungs are not uncommon. The muscles are thin and do not elongate in proportion to the bony skeleton. This affects particularly the flexor groups and accounts for the vertebral curves, the flexion of toes, fingers, knees, etc. Though relatively too short, the muscles are apparently strong and show no signs of change in electrical reaction. When studies have been made, no changes in phosphorus or calcium balance have been noted. There is a marked diminution in the fatty panniculus. The metabolic rate is usually below normal. Although the patients tend toward infantilism, the mental faculties are not disturbed.

No definite etiology of the affection has been established, although endocrine disturbances, and especially the pituitary dysfunction, have been considered to be responsible.

Treatment should be symptomatic, and particularly orthopaedic, to prevent and to correct dislocation or the assumption of vicious attitudes. In view of the tendency toward spontaneous recession of the symptoms after puberty, the author cautions against precipitate surgical intervention.—*Henry Milch, M.D., New York, N.Y.*

OSTEOGENESIS IMPERFECTA TARDA J. Fletcher Lutz and Lewis C. Pusch *Radiology*, XXXII, 391, April 1939.

There has been great confusion in the classification of brittle and soft bones, due largely to the lack of known etiology. They are classified as follows: (1) hereditary type, (2) non-hereditary congenital type (osteogenesis imperfecta congenita and osteogenesis imperfecta tarda), (3) non-hereditary acquired type (osteosclerosis fragilis generalisata), and (4) senile type (osteoporosis). Key has given to cases which show hereditary characteristics, such as china-blue sclera, a tendency to fragilitas ossium, hereditary deafness, and hypermotility of the joints, the name "hereditary hypoplasia of the mesenchyme."

In the foetal form the child is still-born or survives but a short time, with multiple fractures and incomplete ossification of the skull. In the infantile variety, somewhat less severe, the child may survive a few months or a year or two, with incomplete development of the cranial vault and multiple fractures. In osteogenesis imperfecta tarda the infant is apparently born healthy but sustains numerous fractures from slight causes. Some of these children improve as they grow older. Many have blue sclera and show hereditary tendencies.

Roentgenographically, they show evidence of old united fractures, decalcification, and bowing of the long bones with marked thinning of the cortex. Histologically, the epiphyses show no striking changes. The cortex is lacking, thin, or discontinuous. When present, it is composed of incompletely calcified osteoid trabeculae or of so-called "fiber-bone". The medulla is either fibrous or lymphoid, supporting poorly calcified trabeculae, the cortex and medulla being often indistinguishable. As to treatment, favorable results have been reported from the use of thymus, and of dilute hydrochloric acid, high-protein diet, and cod-liver oil.

One case is reported, with very complete history, roentgenographic examination, and gross and microscopic anatomical studies.—*Eduard N. Reid, M.D., Santa Monica, California*

UNUSUAL MANIFESTATIONS OF BONE TUBERCULOSIS. Bernard P. Widmann, Herman W. Ostrum, and Russel F. Miller. *Radiology*, XXXII, 434, April 1939.

A form of tuberculosis involving the short tubular bones of the hands and feet in children, described by Jüngling under the term "osteitis tuberculosa multiplex cystica", presents round or ovoid rarefied areas of cystic appearance, without periosteal reaction or deposits, adjacent bone condensation, or involvement of neighboring joints. It resembles lupus pernio. König described a symmetrical form of bone tuberculosis with resorption and cyst formation. According to Hodges and Phemister, shaft tuberculosis in children is usually primary, starting in the metaphyses, occasionally in the epiphyses, and usually attacking the smaller bones of the hands and feet. Rarefaction is the first roentgenographic sign, followed by periosteal new bone, and when extending into the epiphyses, cavity formation. Shaft tuberculosis is rare in adults, attacking the smaller bones and producing spina ventosa. It produces diffuse destruction of the shaft, with new-bone formation, the destructive process predominating. Harrison describes two types: (1) showing soft granulation tissue without caseation, leading to molecular bone absorption, known as *caries*, and (2) bone softening with caseation, leading to suppuration. *Caries sicca*, irregular erosion without general decalcification, usually occurs in the head of the humerus.

Tuberculosis of the skull, most common in children, starts in the diploe, and destroys bone, making a large opening in the internal plate and a smaller one in the external. In syphilis there is greater destruction of the outer table.

Twenty-one cases are reported. Many of them resembled metastatic malignancy and there was lack of anything characteristic to suggest the nature of the process. In more than 75 per cent. of the cases the diagnosis was confirmed by autopsy or biopsy.—

*Edward N. Reed, M.D., Santa Monica, California.*

THE BONE CHANGES IN PRIMARY HYPOGONADISM. L. M. Hurxthal and Hugh F. Hare. *Radiology*, XXXII, 521, May 1939.

Excluding pituitary disease, hypogonadism may be classified in relation to time of life,—failure of sex hormone to be secreted (1) up to the usual time of puberty, followed by typical primary hypogonadism; (2) shortly after puberty, resulting in partial development of secondary sex characteristics and epiphyseal closure; (3) after epiphyseal closure, when there may be slight regression of sex characteristics or they may remain unchanged.

Apparently the true sex hormones of the gonads bring about epiphyseal closure. In the true hypogonadal giant, growth does not proceed at an abnormal rate but only for an abnormal time. Primary prepubertal hypogonadism produces (1) longer bone growth, (2) delayed epiphyseal closure, (3) subcalcification, (4) thinning of the cortical layer, (5) thin-walled, normal-sized trabeculae, and (6) roughening of metaphyseal margin of growing bone. Dental caries was noted in all the authors' cases. Descriptive findings in eleven cases are given.—*Edward N. Reed, M.D., Santa Monica, California.*

THE JOINT CHANGES IN HEMOPHILIA. Nathan B. Newcomer. *Radiology*, XXXII, 573, May 1939.

Characteristic joint changes are produced by hemophilic hemorrhages. They are often diagnosed as tuberculous or arthritic. According to König's classification, the pathological changes occur in three phases: (1) hemarthrosis, with thickening of the capsule, but without bone changes; (2) panarthrits, with vacuolization in the epiphyses; and (3) the regressive stage, with loss of the cartilage by destruction or absorption due to interference with the circulation, and with pseudo-lipping suggesting osteo-arthritis.

In discussing the joints most commonly involved, the author quotes from an article by Dr. H. B. Thomas, who found them to be, in the order of frequency: knee, ankle, hip, and, more rarely, the small joints. Hemorrhages into the hip joint occurring before maturity produce changes resembling Perthes' disease. Roentgenograms of involved hips

made after maturity show changes resembling healed Perthes' disease, coxa valga, bone-cyst-like formations in the head and neck, and arthritis deformans. Characteristic joint disease occurs in at least 80 per cent. of hemophiliacs.

Three cases are reported in detail.

An excellent summary is given of the three recognized types of hereditary bleeding: hemophilia, hereditary hemorrhagic telangiectasia, and hereditary hemorrhagic diathesis.

—Edward N. Reed, M.D., Santa Monica, California.

THE TREATMENT OF COMPOUND FRACTURES. ANALYSIS OF 100 CASES. Earl D. McBride. *Southern Medical Journal*, XXXII, 243, March 1939.

The author reviews 100 compound fractures treated privately and on the Service at the University Hospital. Five methods were used: (1) Kirschner-wire traction with plaster fixation after débridement and open packing of the wound with vaselin gauze (twenty-six cases); (2) Braun frame or Thomas-splint suspension traction after débridement and open packing of the wound (twenty-two cases); (3) manipulative réduction and plaster fixation after débridement and suturing of the wound (fifteen cases); (4) Braun frame or Thomas-splint suspension traction after débridement and suturing (thirteen cases); and (5) no débridement, wound closed, no drains or splints (twenty-four cases in which the patients were seen late). The first two methods gave decidedly the best results. The third and fourth methods gave a much higher percentage of complications. The worst results were obtained with the fifth method.—Fred G. Hodgson, M.D., Atlanta, Georgia.

REPAIR OF THE ANTERIOR CRUCIATE LIGAMENT OF THE KNEE. Willis C. Campbell. *Southern Medical Journal*, XXXII, 442, April 1939.

"An anterior longitudinal incision about six inches in length is made just medial to and parallel with the quadriceps tendon, patella, and patellar tendon. Dissection is made into the joint cavity throughout the entire incision, and the interior of the joint is carefully inspected; the cartilage is excised, if derangement exists. If the cruciate ligament is severed, repair is made by dissecting a pedicle strip of fascia, capsule, and tendon, eight inches long and about one-third of an inch wide, from the lateral margin of the incision, the dissection being carried down to the attachment of the capsule to the tibia. This strip contains very strong tendinous tissue from the medial border of the quadriceps and patellar tendon. A six-millimeter drill hole is then made on the anteromedial surface of the inner tuberosity of the tibia about one and five-tenths inches below the joint and emerges in the joint at the normal lower attachment of the anterior cruciate ligament just anterior to the spine of the tibia. The same drill is then inserted into the intercondylar notch through the posterior portion of the external condyle of the femur, emerging under the skin above and posterior to the external condyle. A three-inch incision is then made over the point of the drill and dissection is carried down to the bone. A rustless steel wire loop or Macy carrier is then passed from above downward through the drill hole in each bone and the free end of the pedunculated flap brought through to the superior exit of the tunnel in the external condyle of the femur. The flap is now drawn very taut with the knee in about 140 degrees of flexion. About three inches of the strip should extend beyond the tunnel and is stitched to the periosteum and fascia lata. Both the wounds are closed in routine manner, and a posterior splint is applied with the knee in 140 degrees of flexion. The fascial flap replaces anatomically the anterior cruciate ligament, and after it has been attached above there should be no undue anterior gliding of the tibia on the femur." The knee is kept in the posterior splint for three weeks, when active and passive motions are instituted. A cage knee brace may be used for one month longer. Of fourteen cases in which the operation was performed, nine have been traced after more than a year. The results have been excellent in eight cases and poor in one case.—Fred G. Hodgson, M.D., Atlanta, Georgia.



**INJURIES TO THE BONY PELVIS.** Frank D. Dickson. *Southern Medical Journal*, XXXII, 503, May 1939.

The author divides these injuries into three groups: (1) isolated injuries of the pelvic ring; (2) combined injuries of the pubic segment of the pelvic ring; (3) combined injuries of the iliac and pubic segments of the pelvic ring. The first two classes are usually of minor importance, and can be easily treated by rest in bed and some pelvic support. Treatment of the last group is often very complicated, and accurate reduction and maintenance are important in order to obtain good end results. Fracture of the acetabulum with central displacement of the femoral head is also discussed. The author prefers skeletal traction to skin traction. This should be kept up for from six to eight weeks before walking with crutches is allowed. Fracture of the acetabulum with posterior displacement of the femoral head is also discussed.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

**POSTERIOR BONE BLOCK IN TALIPES EQUINUS. SOME FACTORS DETERMINING THE END RESULTS.** W. B. Carrell and H. M. Childress. *Southern Medical Journal*, XXXII, 528, May 1939.

The authors present a review of bone-block operations from the Scottish Rite Hospital and from their Clinic to emphasize the fact that causes for failure in some of their cases are preventable. Of 140 cases, 110 were classified as having good function. Poor results were caused by: (1) inadequate or poorly placed blocks (ten cases); (2) forward displacement of the talus (ten cases); (3) an overactive tendo achillis (ten cases). They conclude that 21 per cent. poor results is too high, and that fully 12 per cent. of these could have been prevented. There are some excellent outline drawings from actual cases. The technique and indications are well described.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

**AIR INJECTION (PNEUMARTHROGRAPHY) AS AN AID IN THE DIAGNOSIS OF INDUSTRIAL AND ATHLETIC INJURIES OF THE KNEE JOINT.** A. Scott Hamilton. *Southern Medical Journal*, XXXII, 533, May 1939.

This procedure is indicated "in those cases demonstrating persistent disability and in which the diagnostic picture is not clear. The method is contra-indicated when dense fibrous adhesions are suspected, when an unrelieved effusion is present, and in hemophilia. Pyarthrosis is not a contra-indication." The technique is described. A 1-per-cent procaine hydrochloride solution is used to infiltrate the skin and subcutaneous tissue. Roentgenograms are then taken in four positions. The author speaks of "positive" and "negative" contrast media. Air is "negative", and is generally preferred. Few reactions have occurred, and no deaths or stiff knees have resulted. The interpretation of films is discussed. Fourteen cases are reported.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

**A FINGER CALIPER FOR REDUCTION OF PHALANGEAL AND METACARPAL FRACTURES BY SKELETAL TRACTION.** Ralph W. Carr. *Southern Medical Journal*, XXXII, 543, May 1939.

"The instrument consists of two easily separated parts, both made of stainless steel, type 18-8. The caliper proper is a U-shaped bar, approximately four inches long, one and one-eighth inches wide, and one-eighth of an inch in diameter. The free ends are tapered and turned in at a right angle. The other part is the flexible yoke which serves to hold the points of the caliper in the cortex of the phalanx by means of a set screw. . . . The caliper was designed to exert traction on the proximal, middle, or terminal phalanx." An incision, one-quarter of an inch long, is made in the skin on each side of the phalanx and the points are engaged in the cortex of the bone. The caliper is well tolerated.—

*Fred G. Hodgson, M.D., Atlanta, Georgia.*

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